The Human Breast in Health and Disease: The Basics

1. Structure
2. Function
3. Cancer

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February 17, 2021

The Human Breast Gross and Subgross Anatomy

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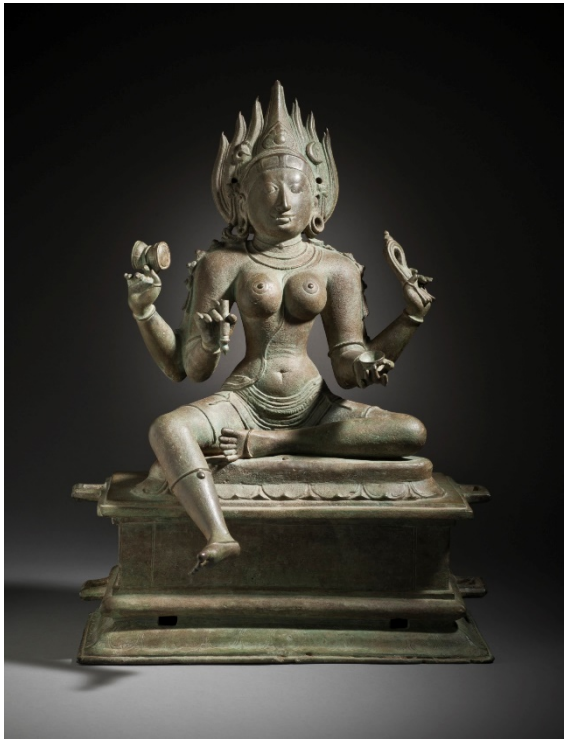
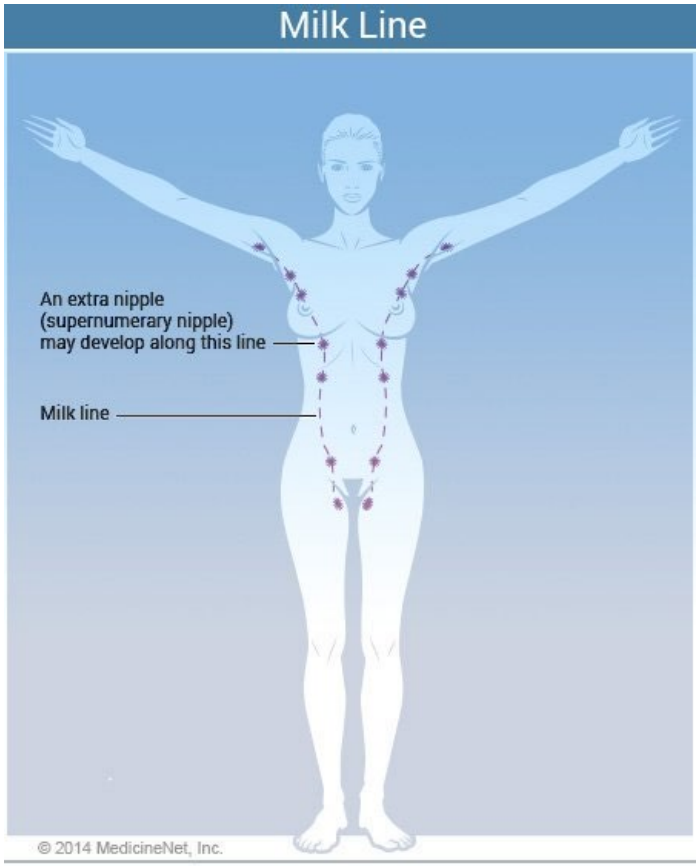
The Natural Human Breast

- The Milk Line (The beginning)
- Structural Non-Mammary Components
  - Connective Tissue
  - Adipose Tissue
  - Vascular and Lymphatics
- The Mammary Gland
  - Outlet Ostea (Nipple)
  - Ducts and Lobes (Collecting System)
  - **THE TDLU** (The Key Structure)
    - Structure and function
    - Menstrual Cycle
    - Life Cycle

SHYAMALA GOPALAN



KALI



THE MILK LINE

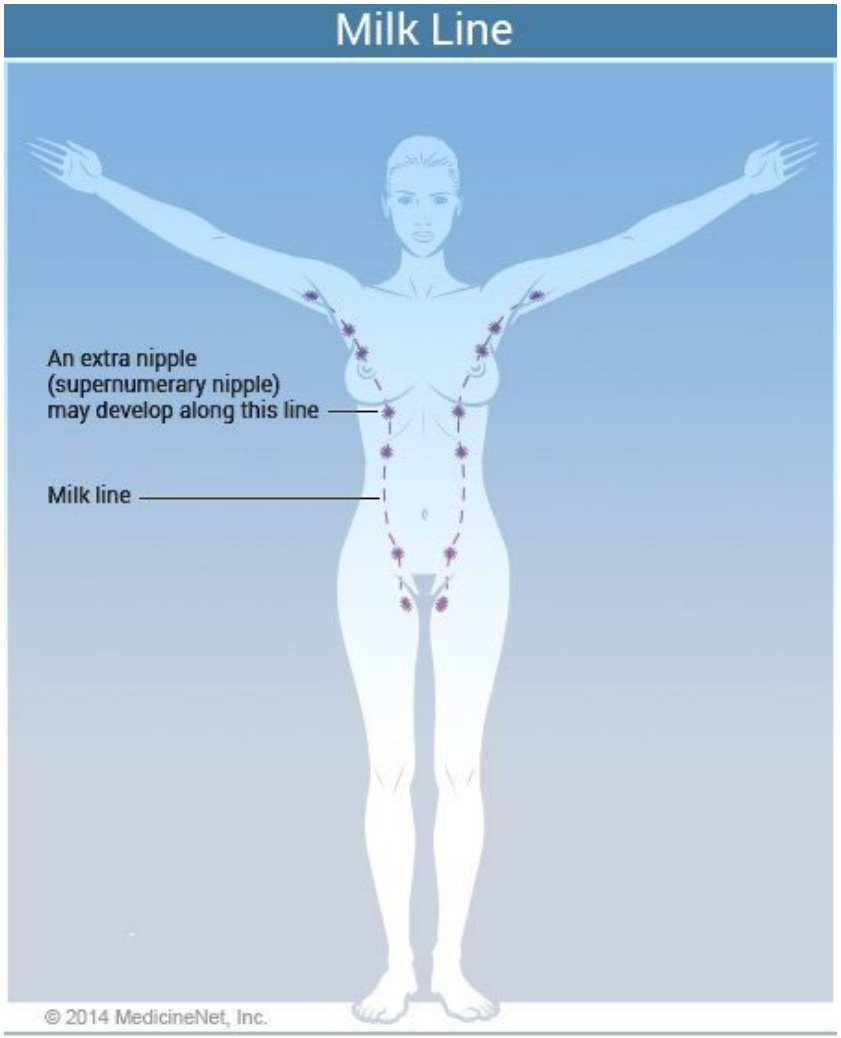
DIANA

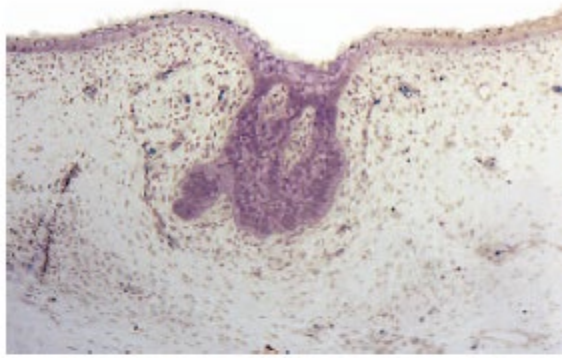
SHYAMALA GOPALAN

SHYAMALA, G.

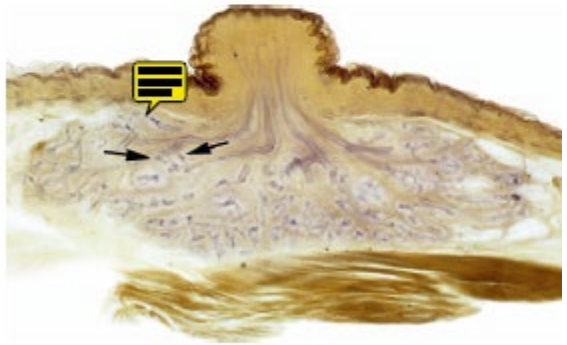
SHYAMALA HARRIS
Kamala and Maya

FROM PLACODE TO EARLY DEVELOPMENT

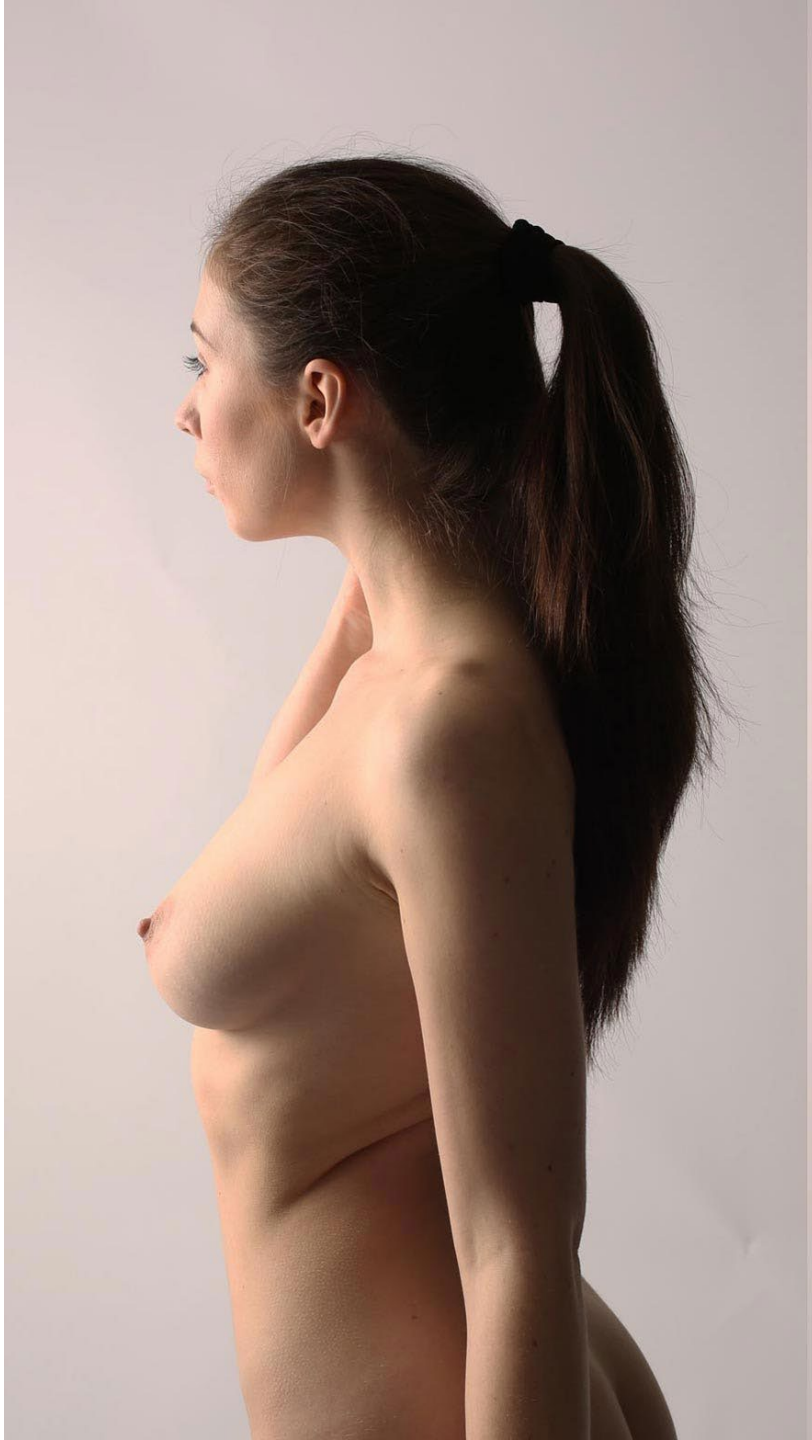


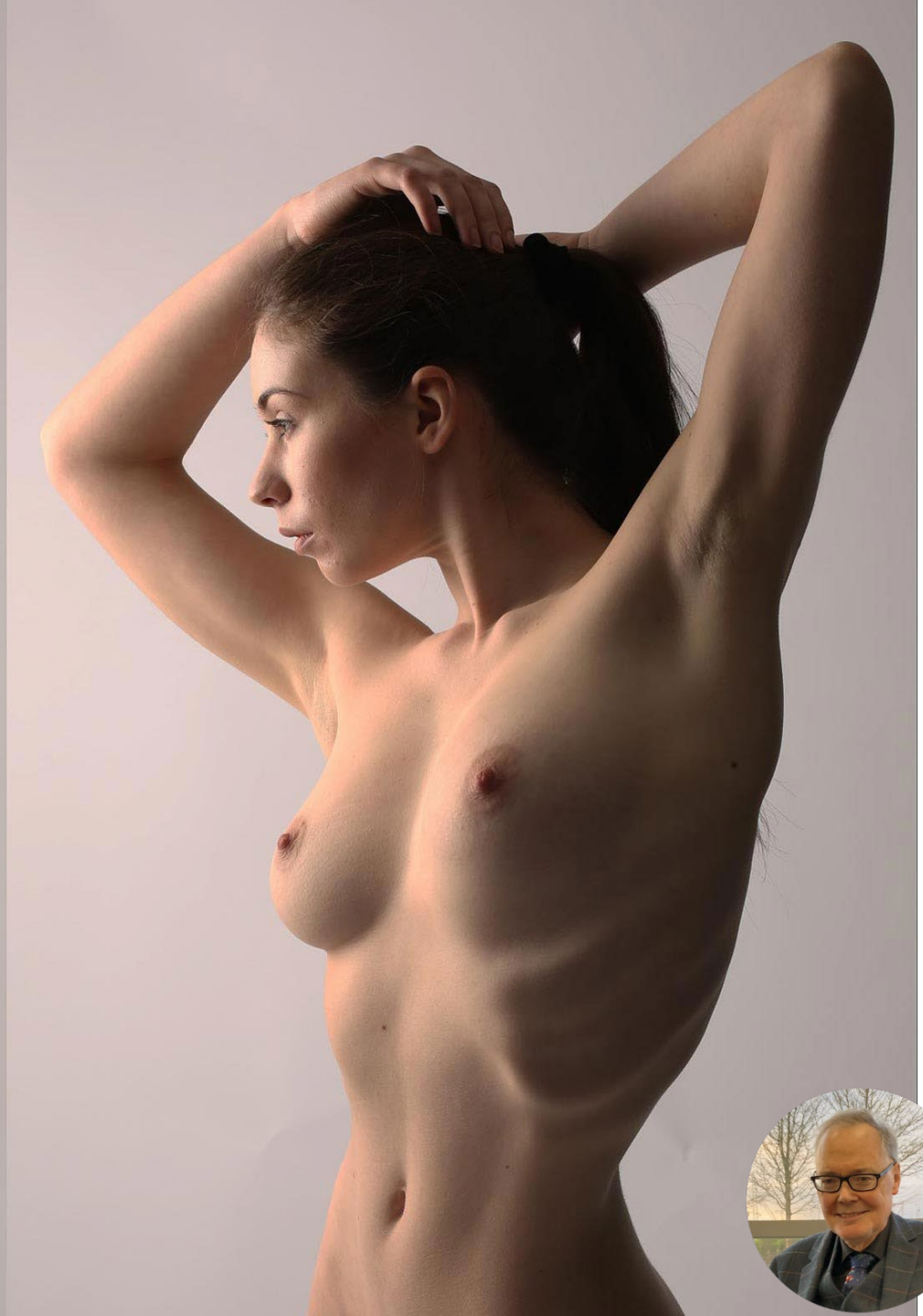


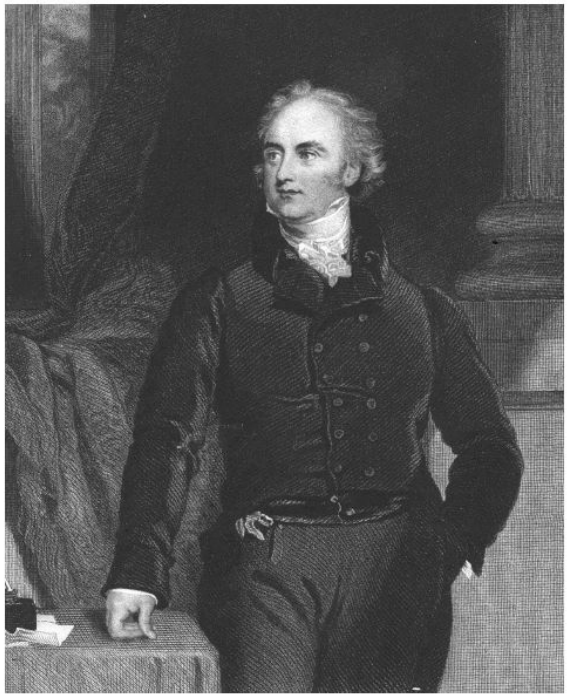
10 **FIGURE 7 Human mammary gland development.** The mammary glands arise as condensations along the milk lines. This image shows the primitive milk bud from a human fetus.



15 **FIGURE 8 Human neonatal mammary gland (subgross).** Early development of the human mammary gland is shown here in a subgross of a neonatal gland with the nipple and growing mammary structure. Note how multiple lactiferous ducts supply separate lobules.







Sir Astley Paston Cooper. Steel engraving after the portrait by Sir Thomas Lawrence.

ON

THE ANATOMY

OF THE

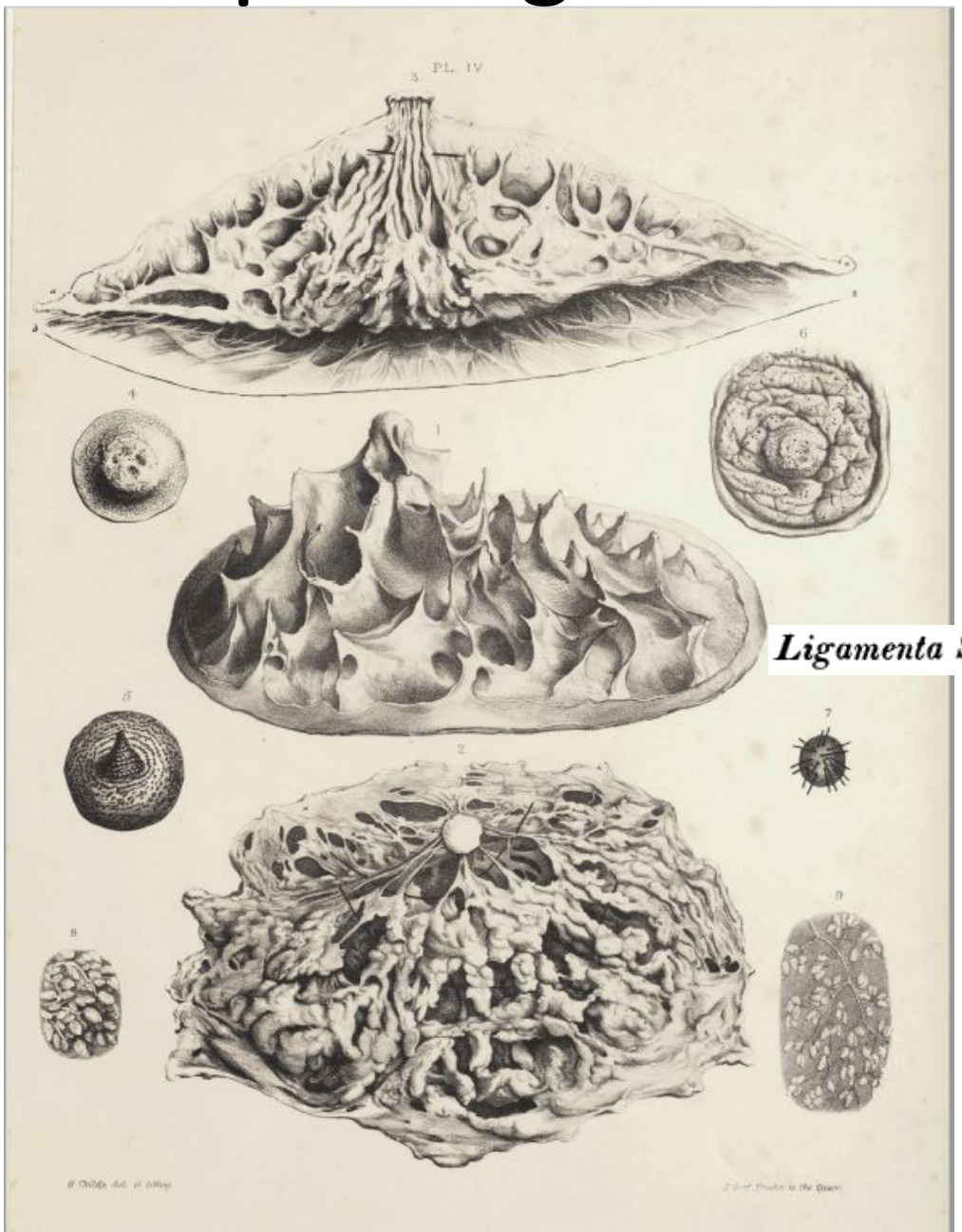
BREAST.

BY

SIR ASTLEY PASTON COOPER, BART.,
F.R.S., D.C.L., G.C.H.,
SERJEANT-SURGEON TO THE QUEEN; CONSULTING SURGEON OF GUY'S HOSPITAL;
MEMBER OF THE NATIONAL INSTITUTE OF FRANCE;
&c. &c. &c.

LONDON:
LONGMAN, ORME, GREEN, BROWN, AND LONGMANS.
1840.

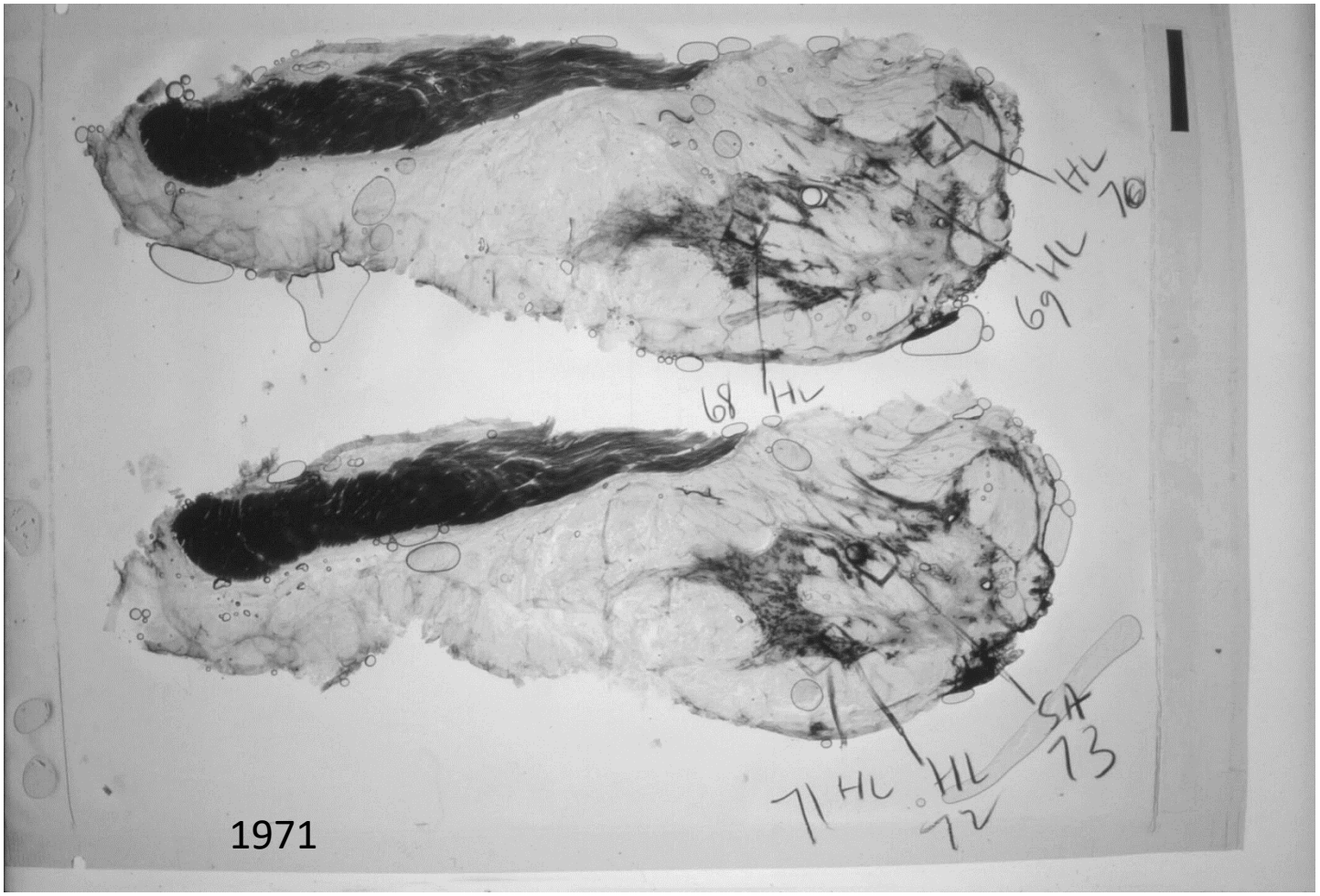
Cooper’s ligaments



Red Wax Anatomy of Ducts

SEFTON R. WELLINGS

WELLINGS AND JENSEN SUBGROSS SECTIONS



1971

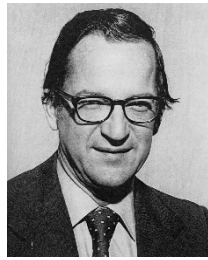
WELLINGS AND JENSEN SUBGROSS SECTIONS

J Natl Cancer Inst. 1975 Aug;55(2):231-73.

An atlas of subgross pathology of the human breast with special reference to possible precancerous lesions.

Wellings SR, Jensen HM, Marcum RG.

PMID: 169369



An Atlas of Subgross Pathology of the Human Breast With Special Reference to Possible Precancerous Lesions [1, 2]

S. R. Wellings,[3] H. M. Jensen,[3] *and* R. G. Marcum [4]

SUMMARY—One hundred ninety-six whole human breasts were examined by a subgross sampling technique with histologic confirmation. The method permitted the enumeration and identification of essentially all the focal dysplastic, metaplastic, hyperplastic, anaplastic, and neoplastic lesions. Of the 196, 119 were suitable for complete quantitative morphologic analysis of the focal lesions by type. They consisted of 67 breasts obtained by autopsy, 29 cancerous breasts obtained by mastectomy, and 23 contralateral to those with cancer. All lesions, photographed subgrossly, were subsequently confirmed and correlated histologically. Morphologic evidence supported the hypothesis that most lesions traditionally grouped as mammary dysplasia or fibrocystic disease, including apocrine cysts, sclerosing adenosis, fibroadenomas, various forms of lobules (sclerotic, dilated, hypersecretory, hyperplastic, atypical, or anaplastic), ductal carcinoma in situ (DCIS), and lobular carcinoma in situ (LCIS), arose in terminal ductal-lobular units (TDLU) or in the lobules themselves. A probable exception was papilloma of ducts larger than terminal ones. Isolated foci of DCIS within the TDLU were seen in 40% of cancerous breasts, which indicated that the disease often was multifocal. Of the contralateral breasts, the 60% with clinical cancer contained such lesions, and data were in accord with the clinically

This study originated 7 years ago as a search for precancerous lesions in the human breast. From the outset, the rationale was based on our prior experience with rodent models. In these systems, the study of wholemounts permits the recognition and quantification of focal lesions that stand out from the background appearance of the mammary gland. The most famous rodent lesion is the hyperplastic alveolar nodule(s) (HAN) first described by Apolant in 1906 (*1*) and again by Haaland in 1911 (*2*). The HAN was proved to be preneoplastic by direct experimental means; its presence is partly the result of activity of the mammary tumor virus (MTV), and it is probably a site of MTV synthesis (*3–5*). In the mouse, HAN have at least six additional properties relevant to the human problem (*6–14*): 1) HAN are much more common in strains that have a high incidence of mammary cancer than in those with low incidence, 2) they increase in number with age, 3) they show variable degrees of independence from the hormones that support and maintain normal mammary gland growth and development, 4) they are lobulo-alveolar, 5) they are large enough to be visible at low powers (2–4×) of the dissecting microscope and at times with the unaided eye,

J Natl Cancer Inst. 1975 Aug;55(2):231-73.

An atlas of subgross pathology of the human breast with special reference to possible precancerous lesions.

Wellings SR, Jensen HM, Marcum RG.

JAMES J. GOING

2004

Available online http://breast-cancer-research.com/content/8/4/107

Commentary

Ductal-lobar organisation of human breast tissue, its relevance in disease and a research objective: vector mapping of parenchyma in complete breasts (the Astley Cooper project)

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Breast Cancer Research 2006, **8**:107 (doi:10.1186/bcr1527)

Journal of Pathology
J Pathol 2004; **203**: 538–544
Published online in Wiley InterScience (www.interscience.wiley.com). **DOI:** 10.1002/path.1556

Original Paper

Escaping from Flatland: clinical and biological aspects of human mammary duct anatomy in three dimensions

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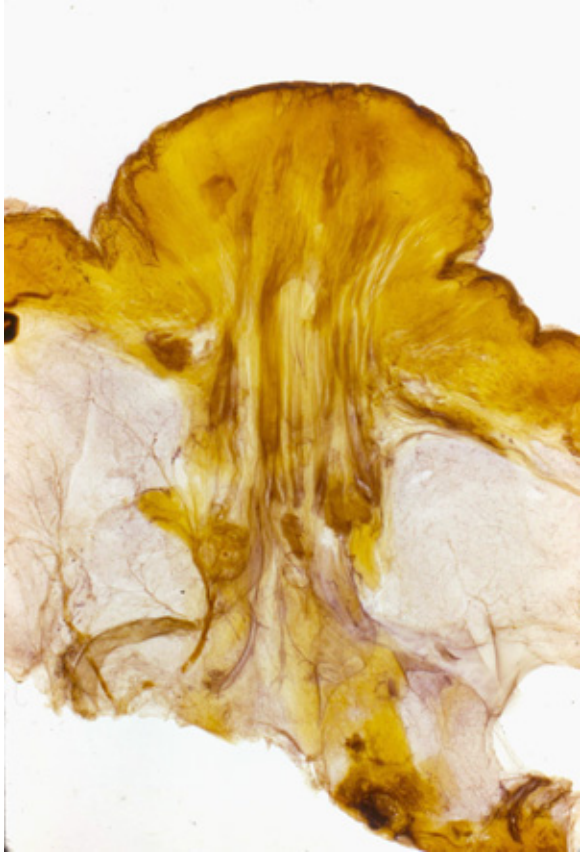
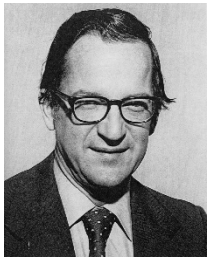
[1]*Department of Pathology, University of Glasgow, Glasgow, UK*
[2]*Glasgow Royal Infirmary, Glasgow, UK*

Correspondence to:

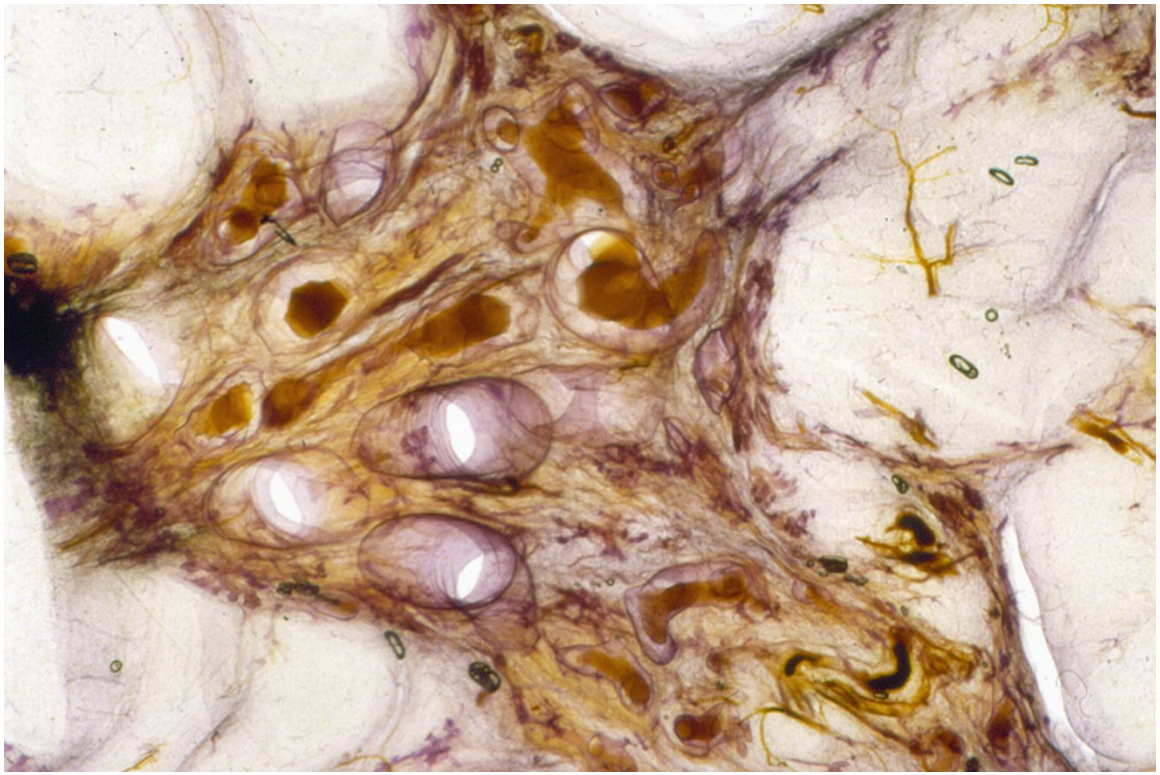
Abstract

ADULT NIPPLE “SUBGROSS”
Ostea

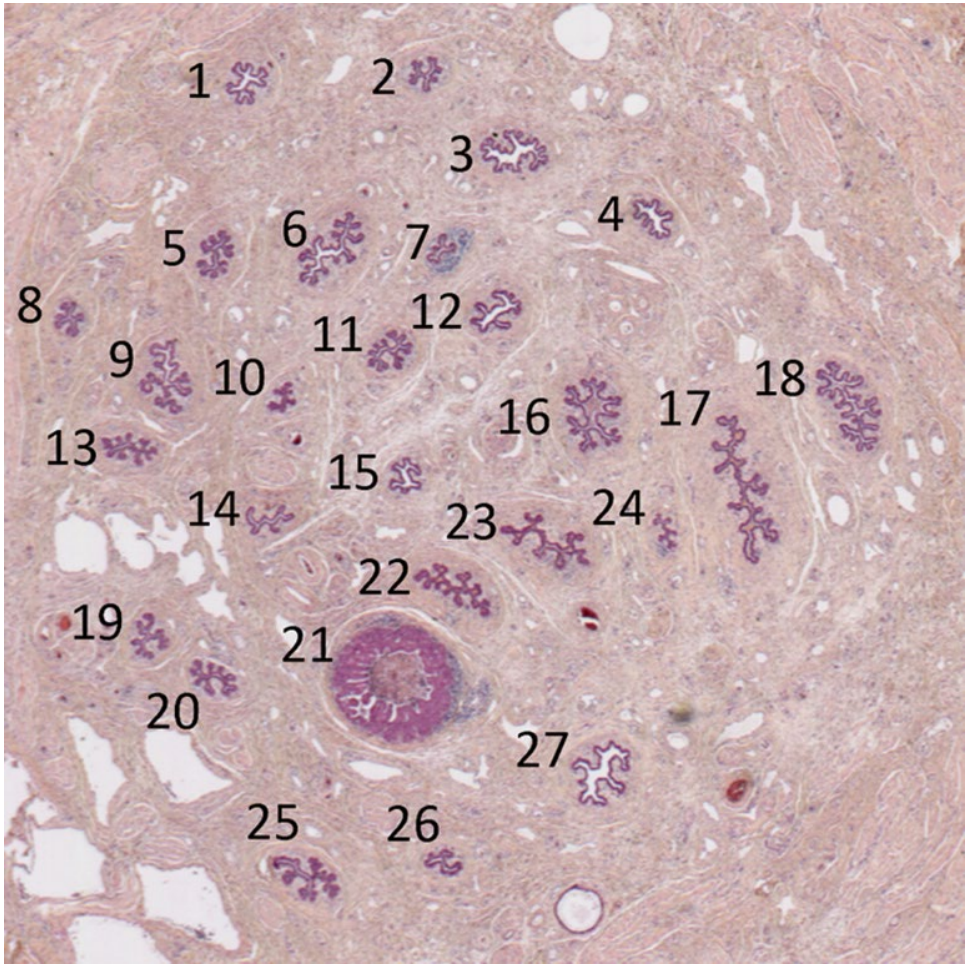




Wm cross-section
Nipple Ostea



Nipple-Central-Ducts-CrossSection-lo mag-rdc-psd



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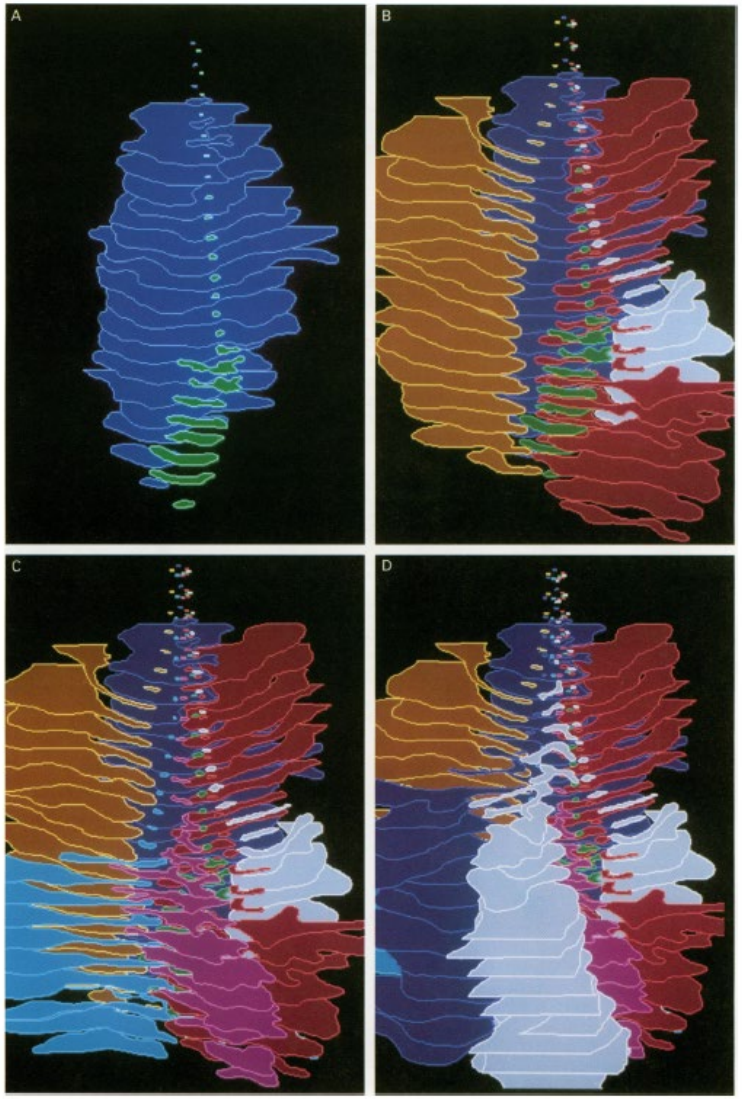

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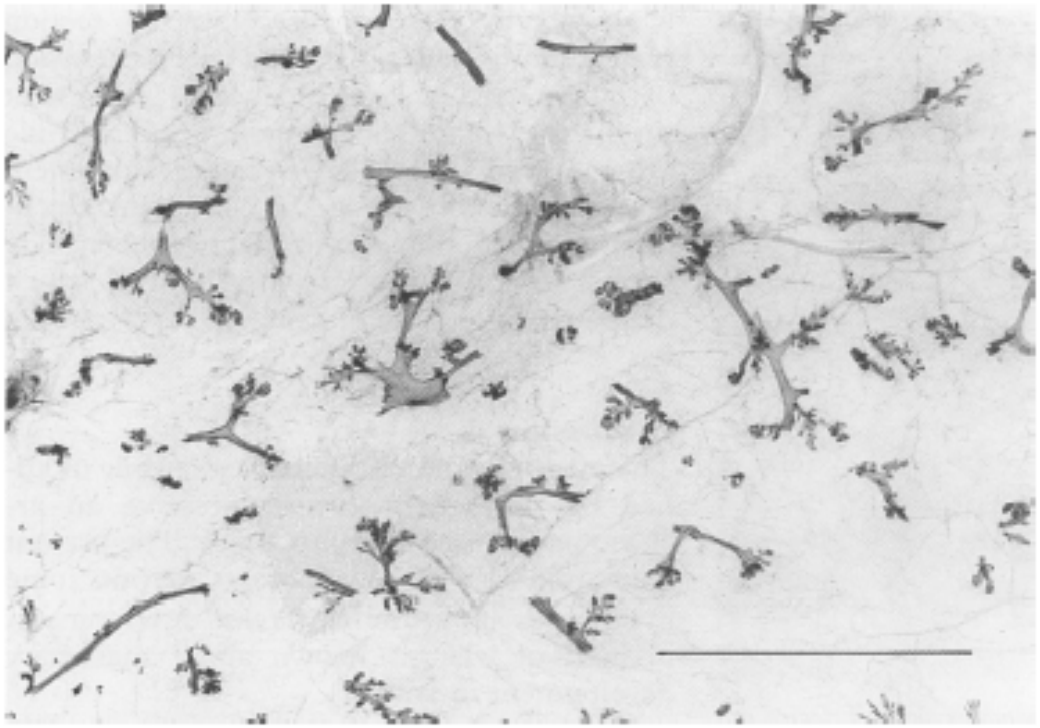
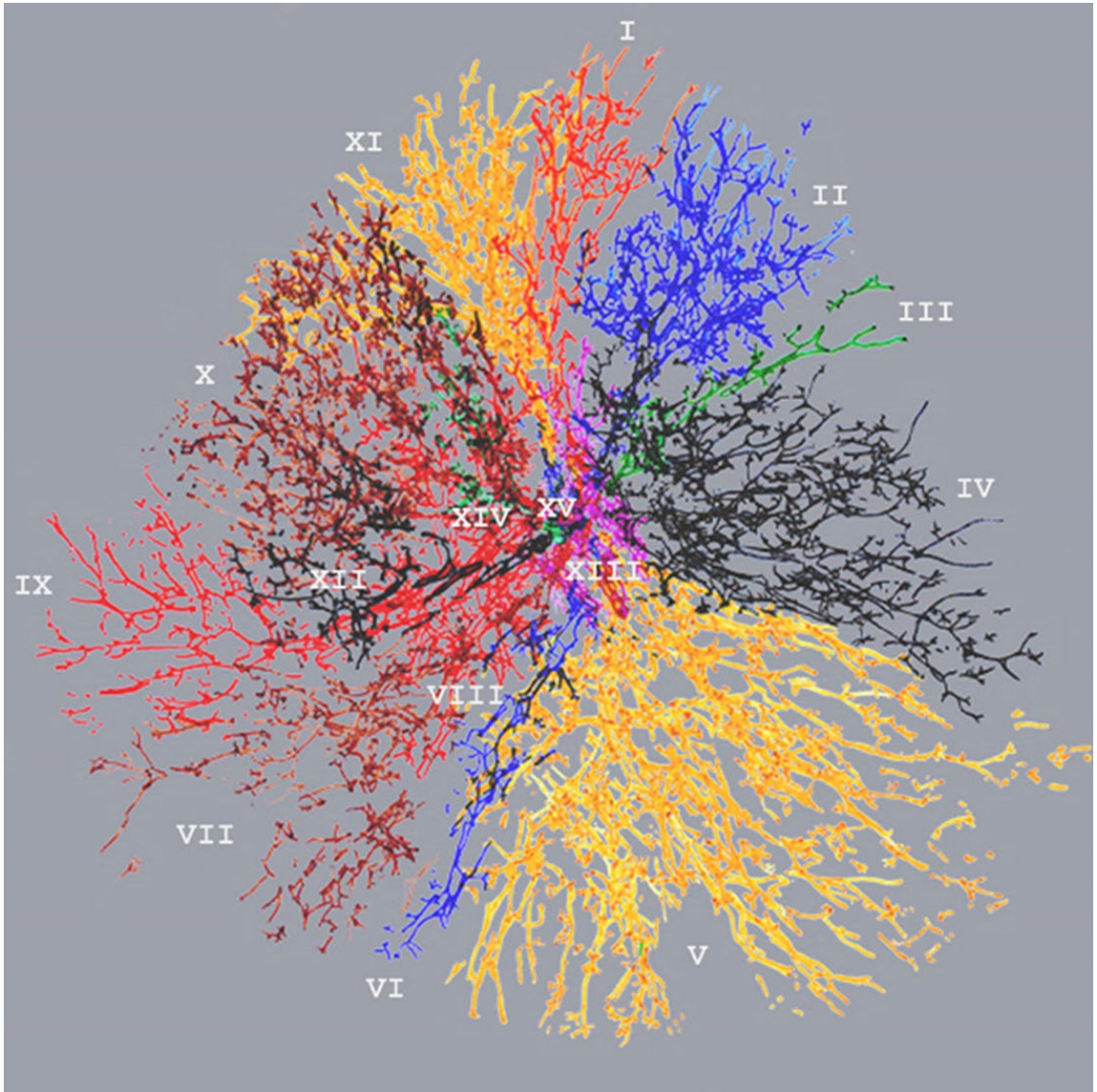
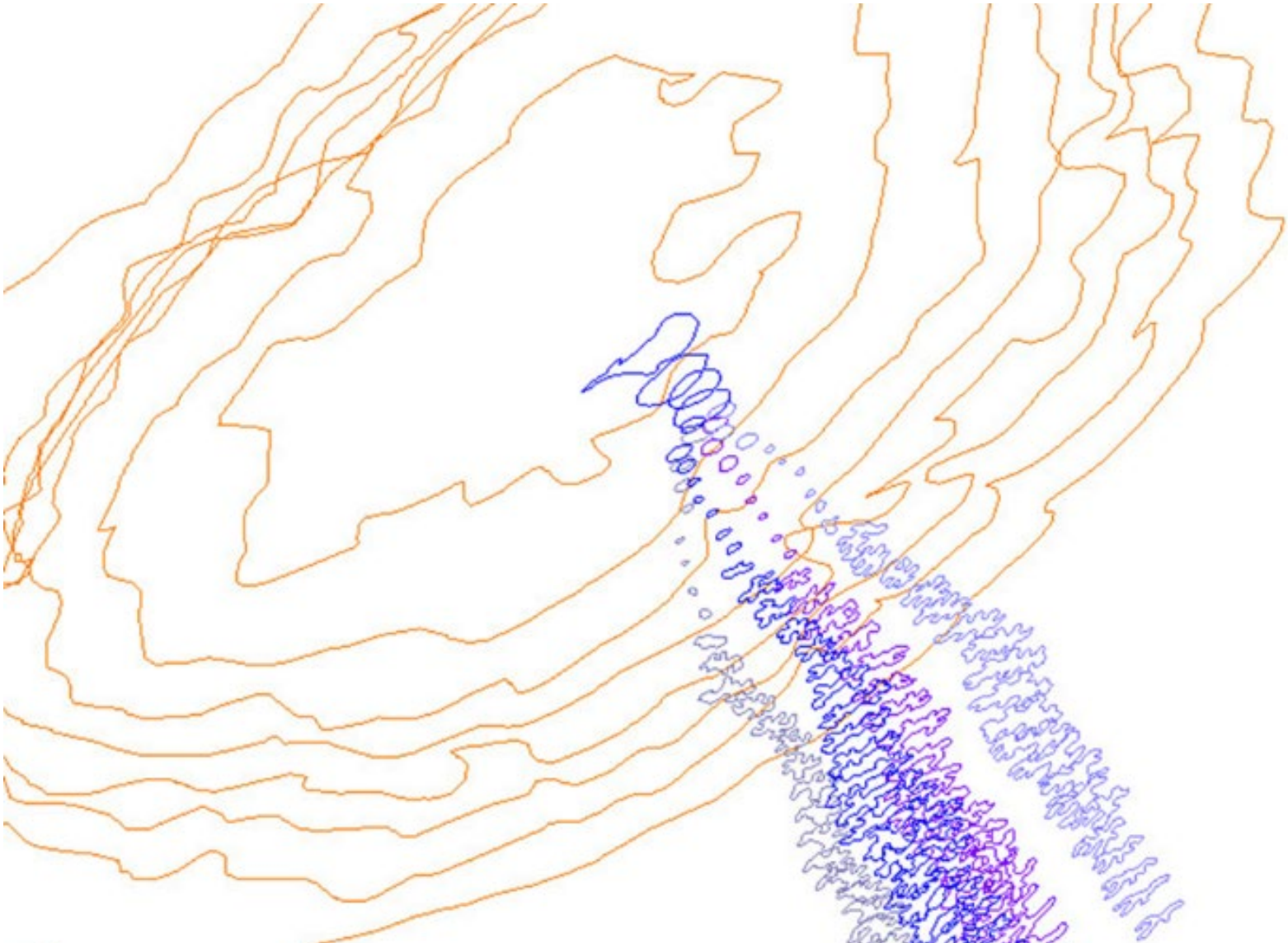


Figure 1 Section of human breast tissue, 2 mm thick, stained with haematoxylin and cleared with methyl salicylate. Many ducts traverse the slice, branch, and give rise to terminal duct lobular units. Scale bar is 10 mm.

COMPUTER RECONSTRUCTION by Going



SHARED OSTEUM



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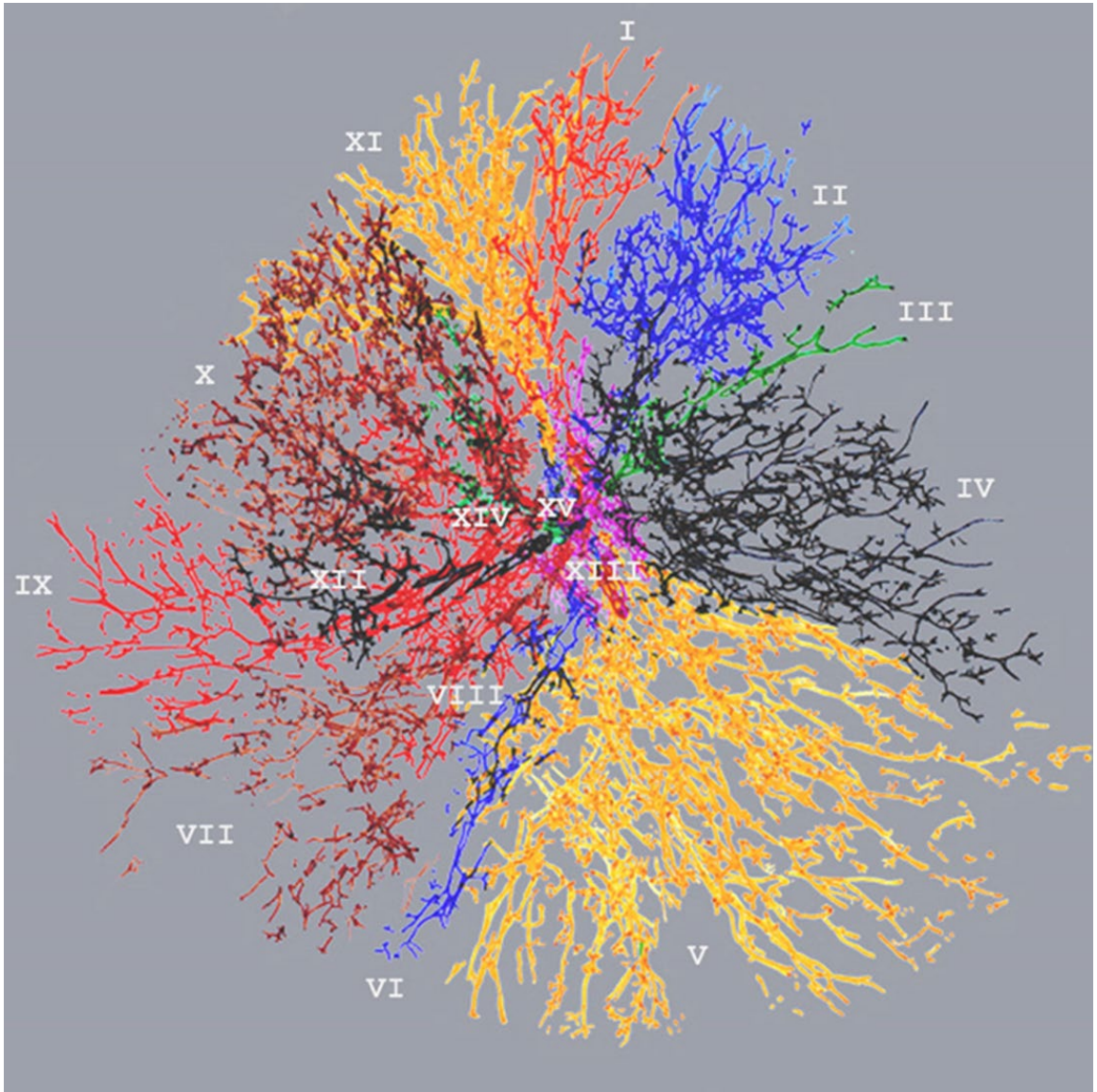
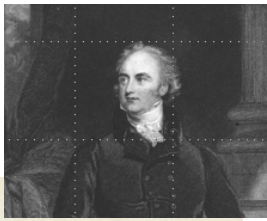
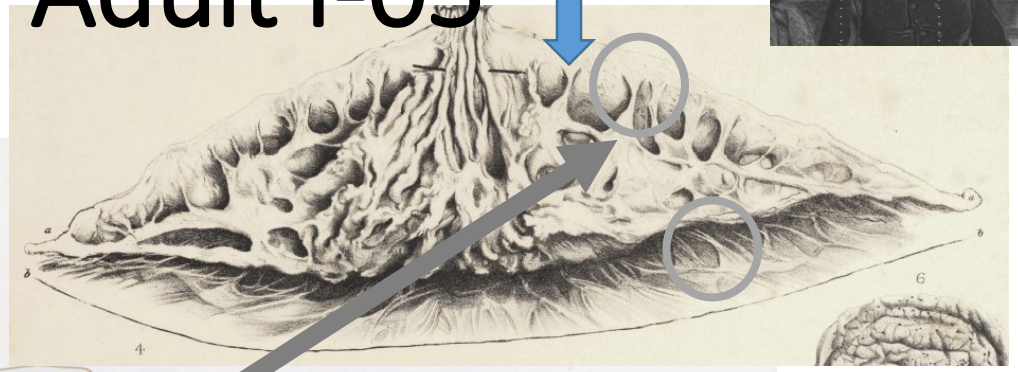
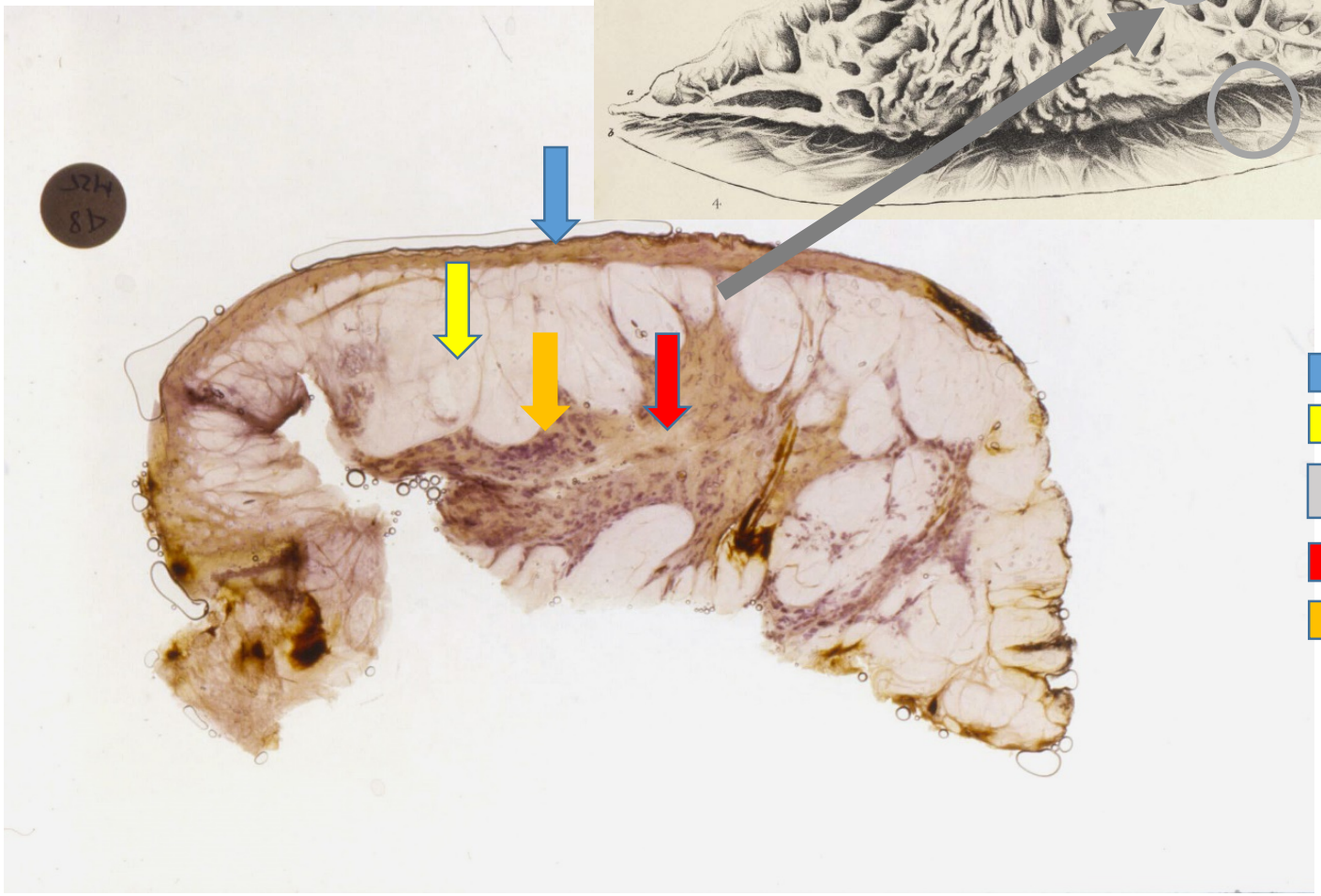


Normal Adult I-05







SKIN

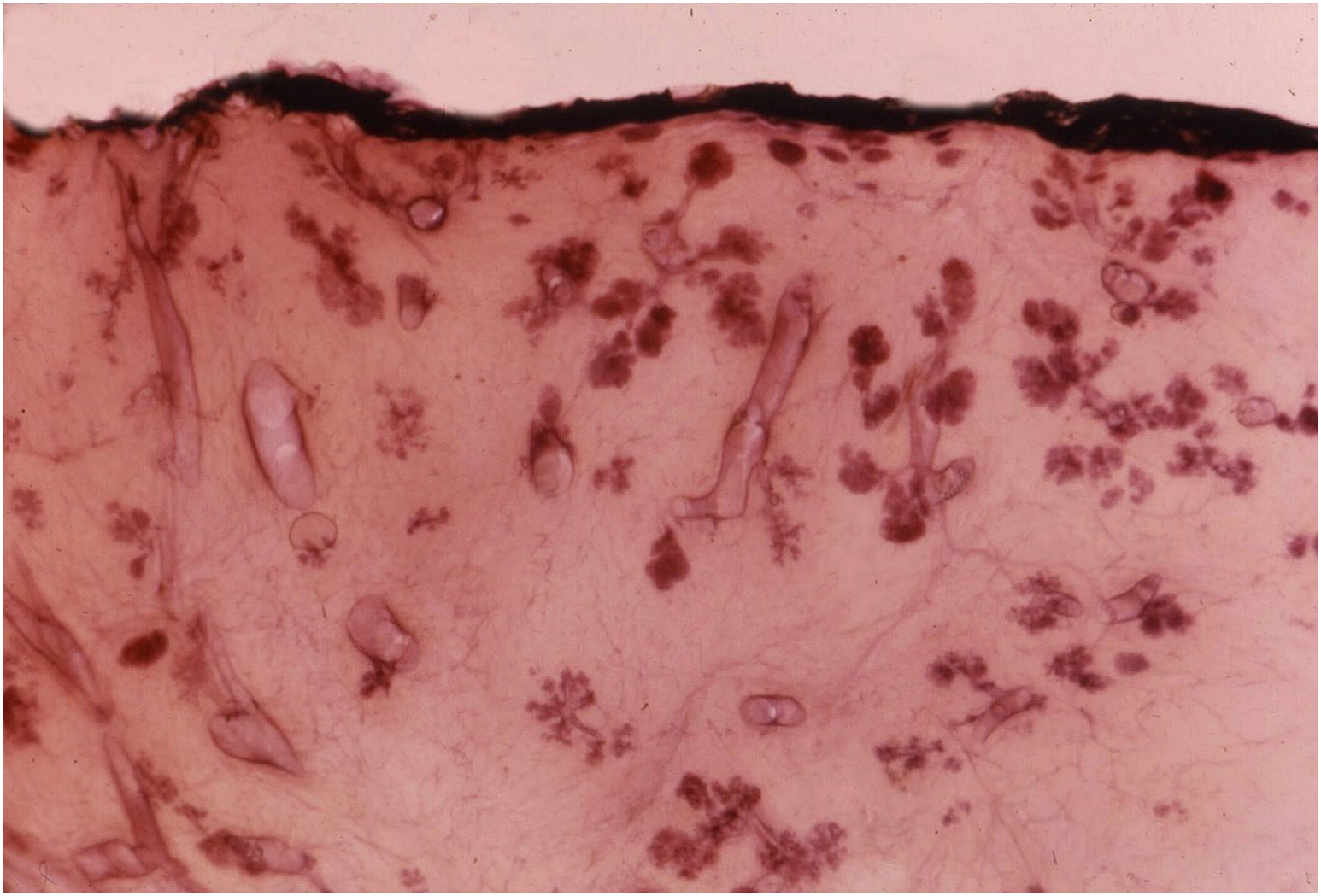
FAT

LIGAMENT

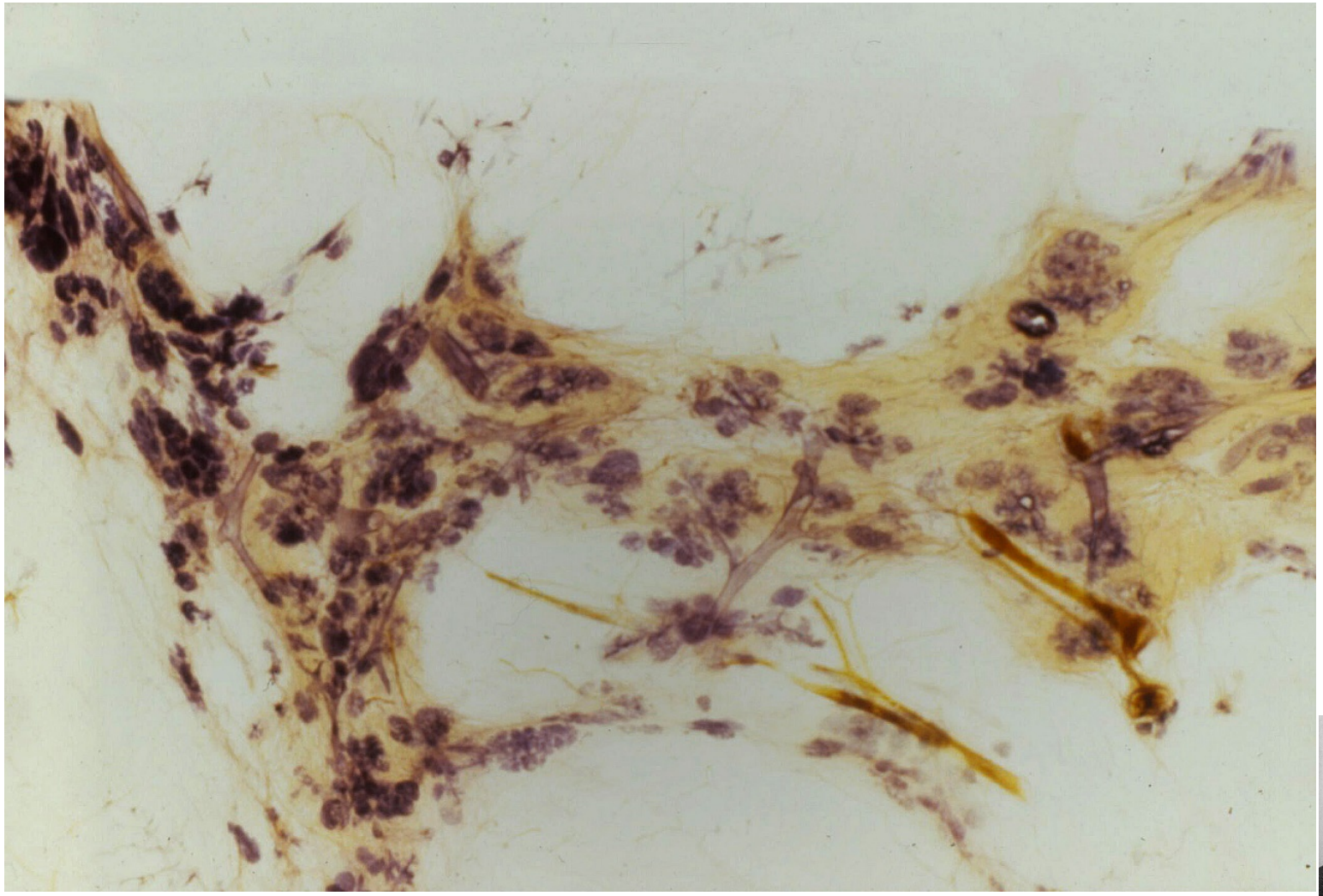
SEPTA

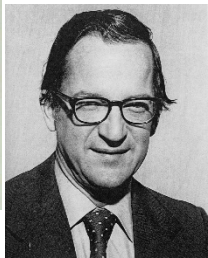
TDLU

NORMAL HUMAN BREAST SUBGROSS

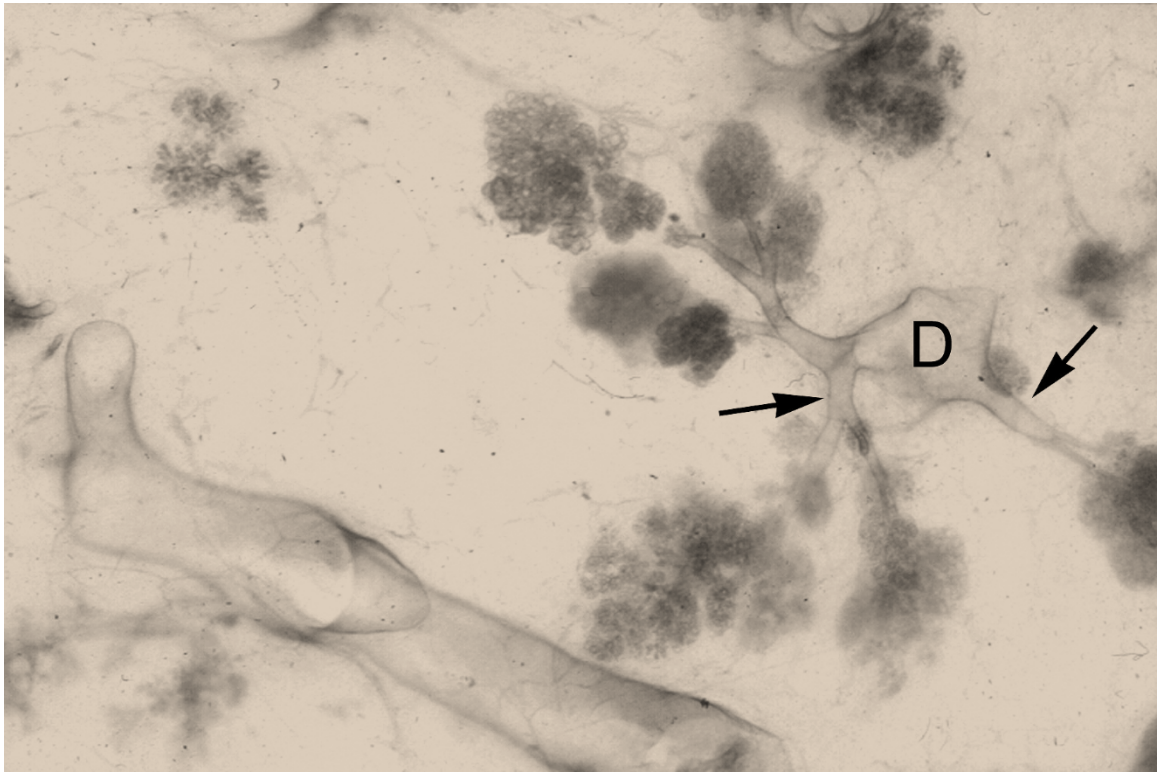


D-05-TDLU-SG





slide26WM-TDLU



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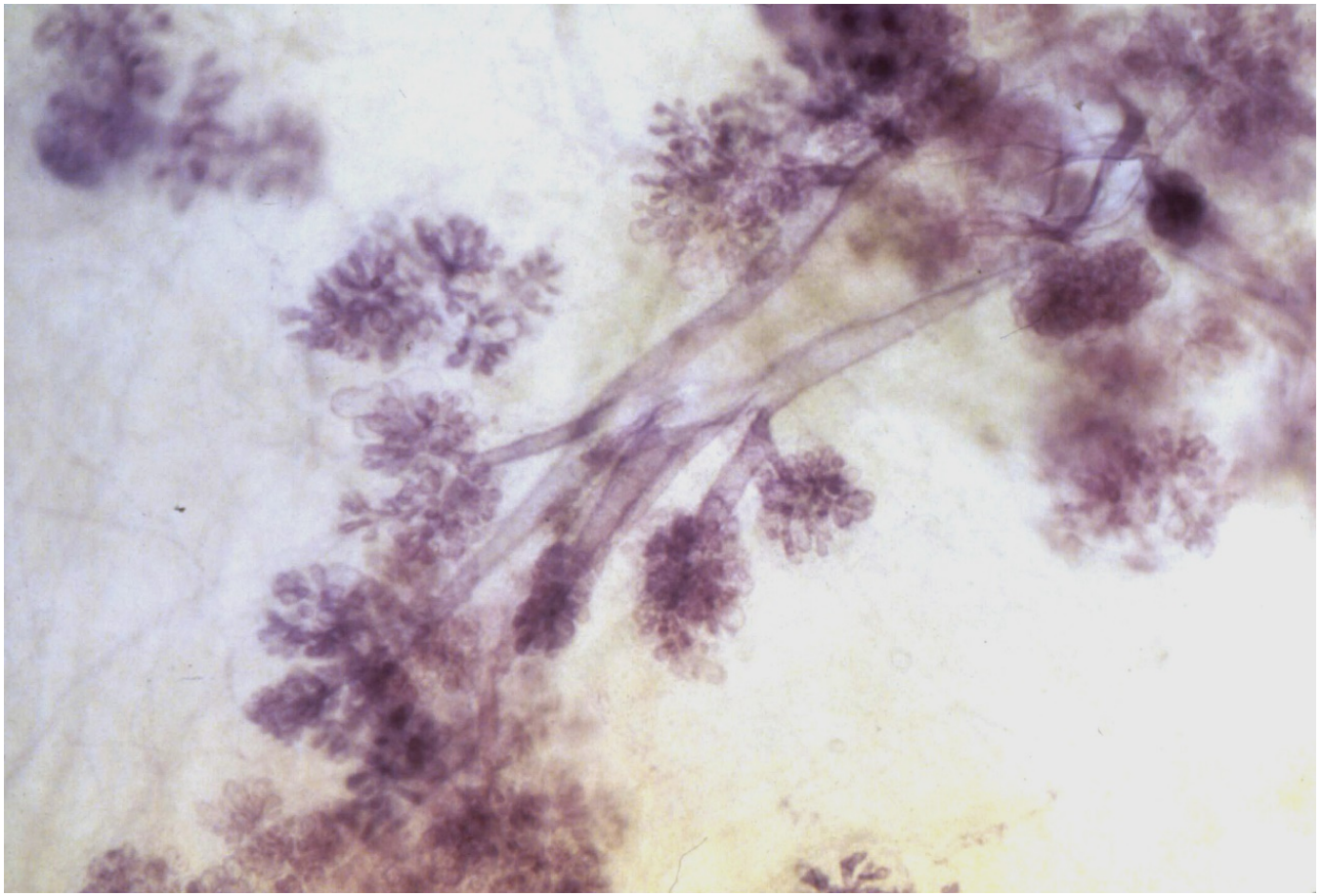
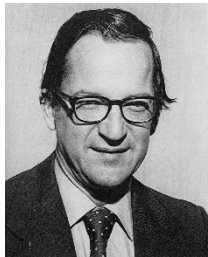
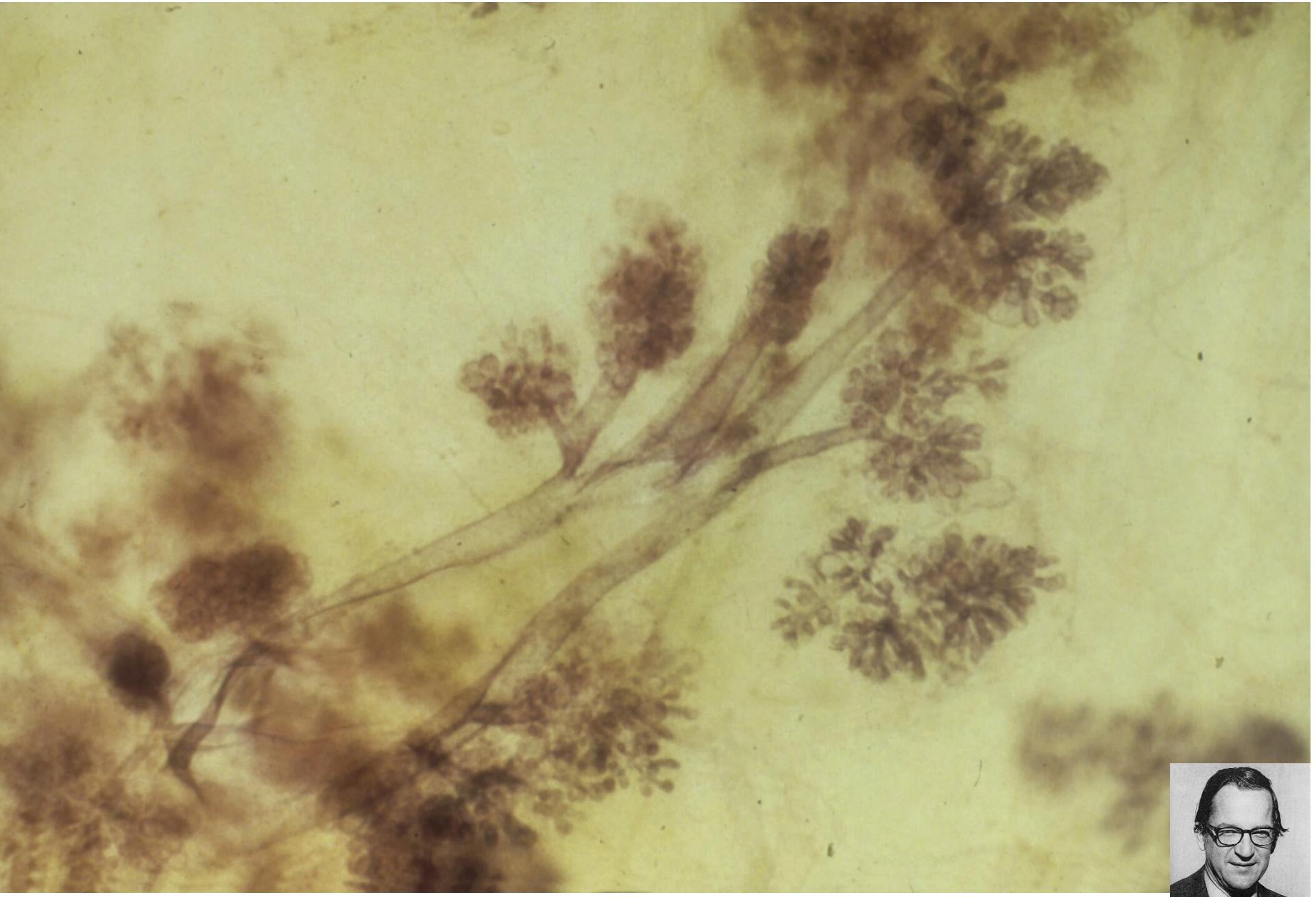






TDLU

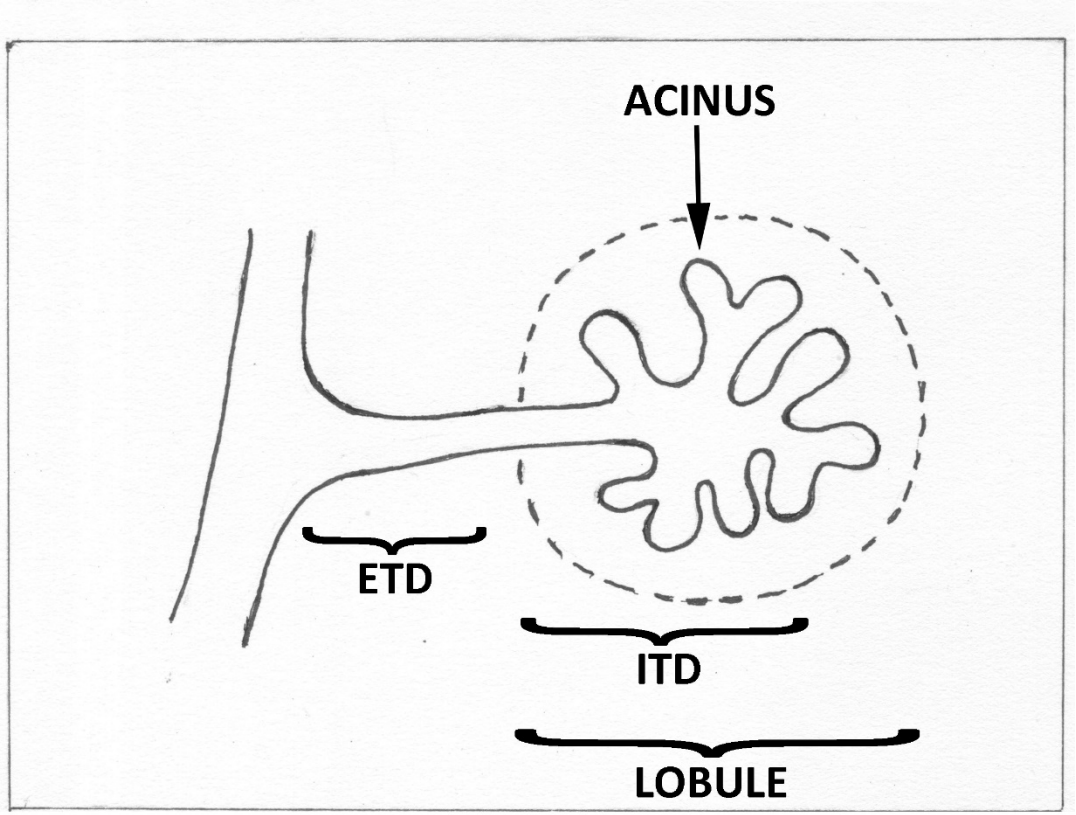
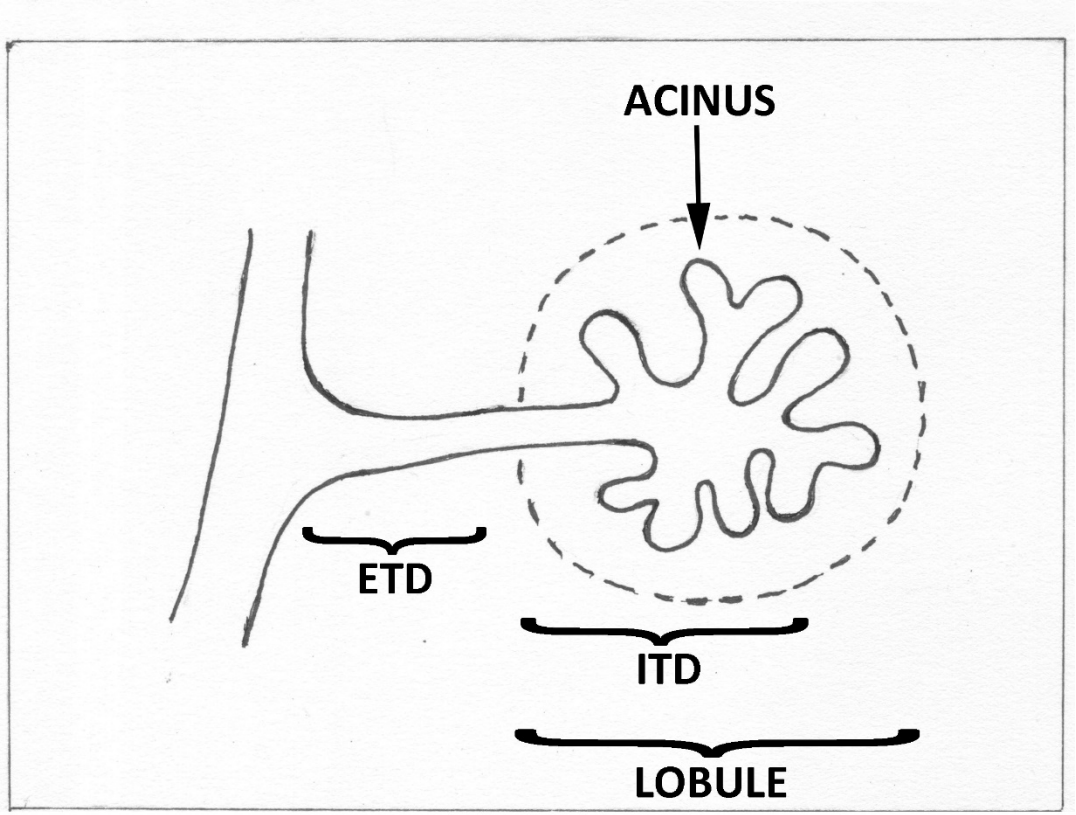


FIGURE 8

Diagram of Terminal Ductal Lobular Unit (TDLU). ETD: Extralobular Terminal Duct. ITD: Intralobular Terminal Duct, which is the axial core of the lobule. A: Acinus (or alveolus or ductule).

Subgross and Functional Histology



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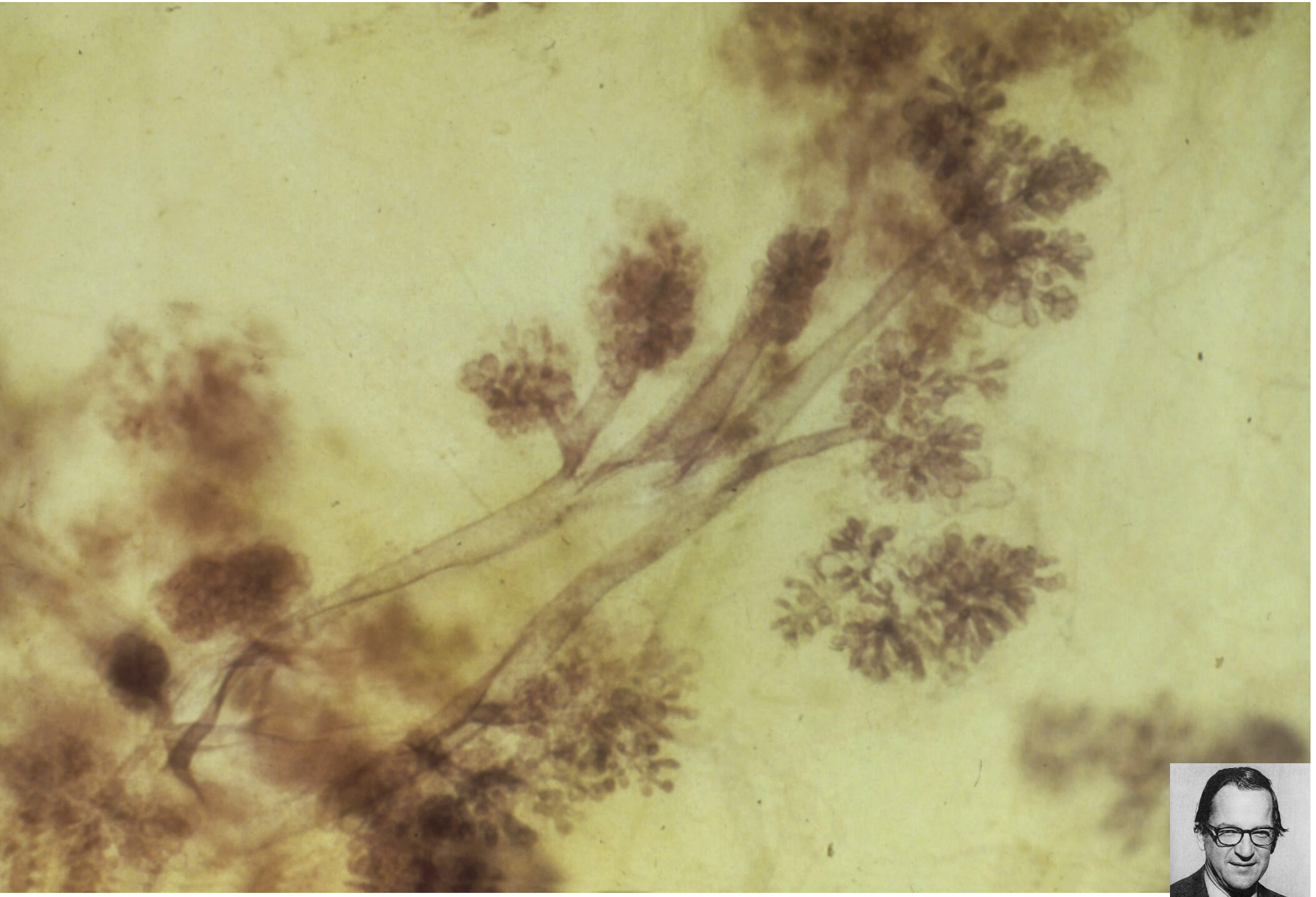
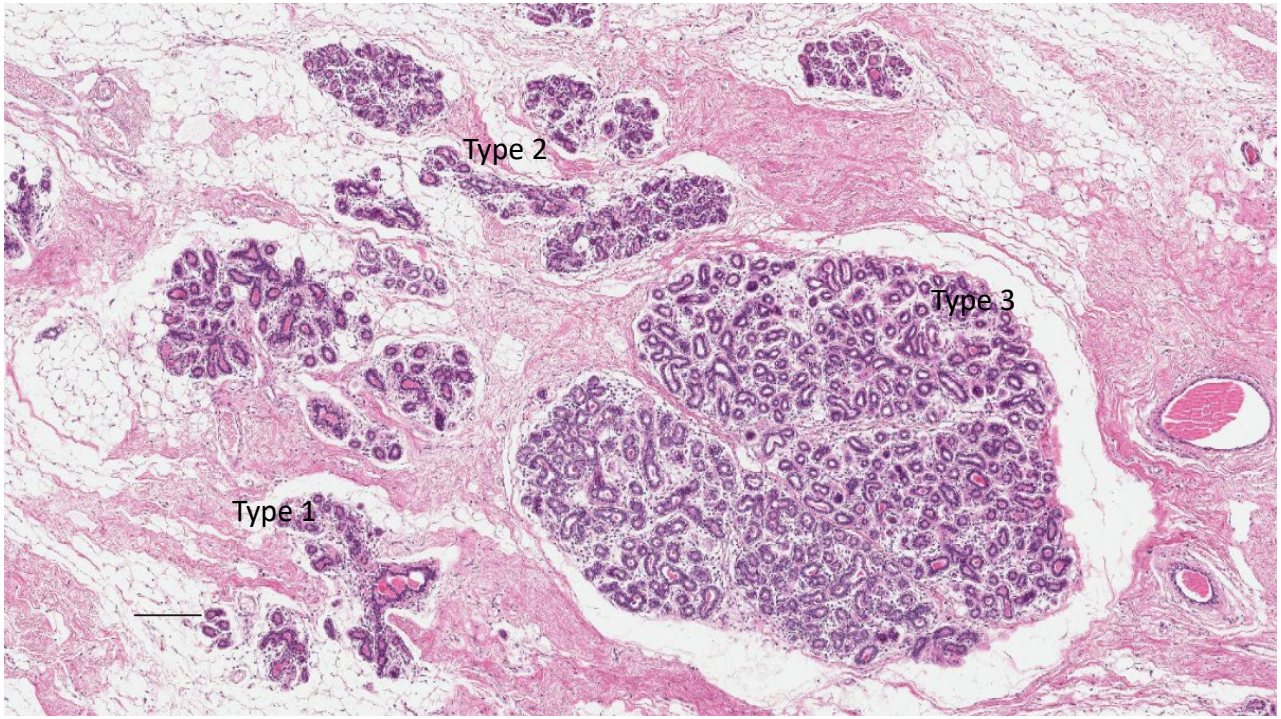
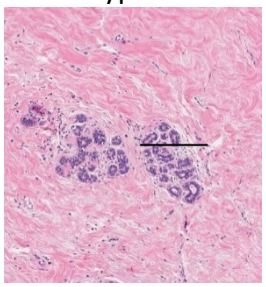
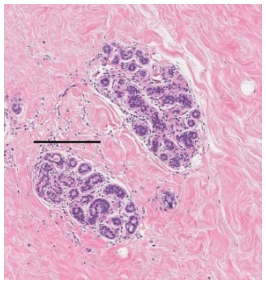
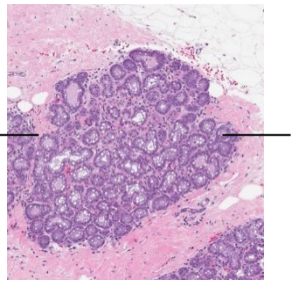
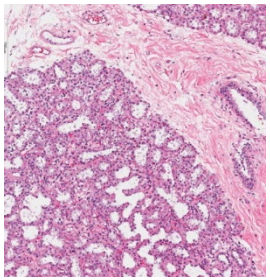








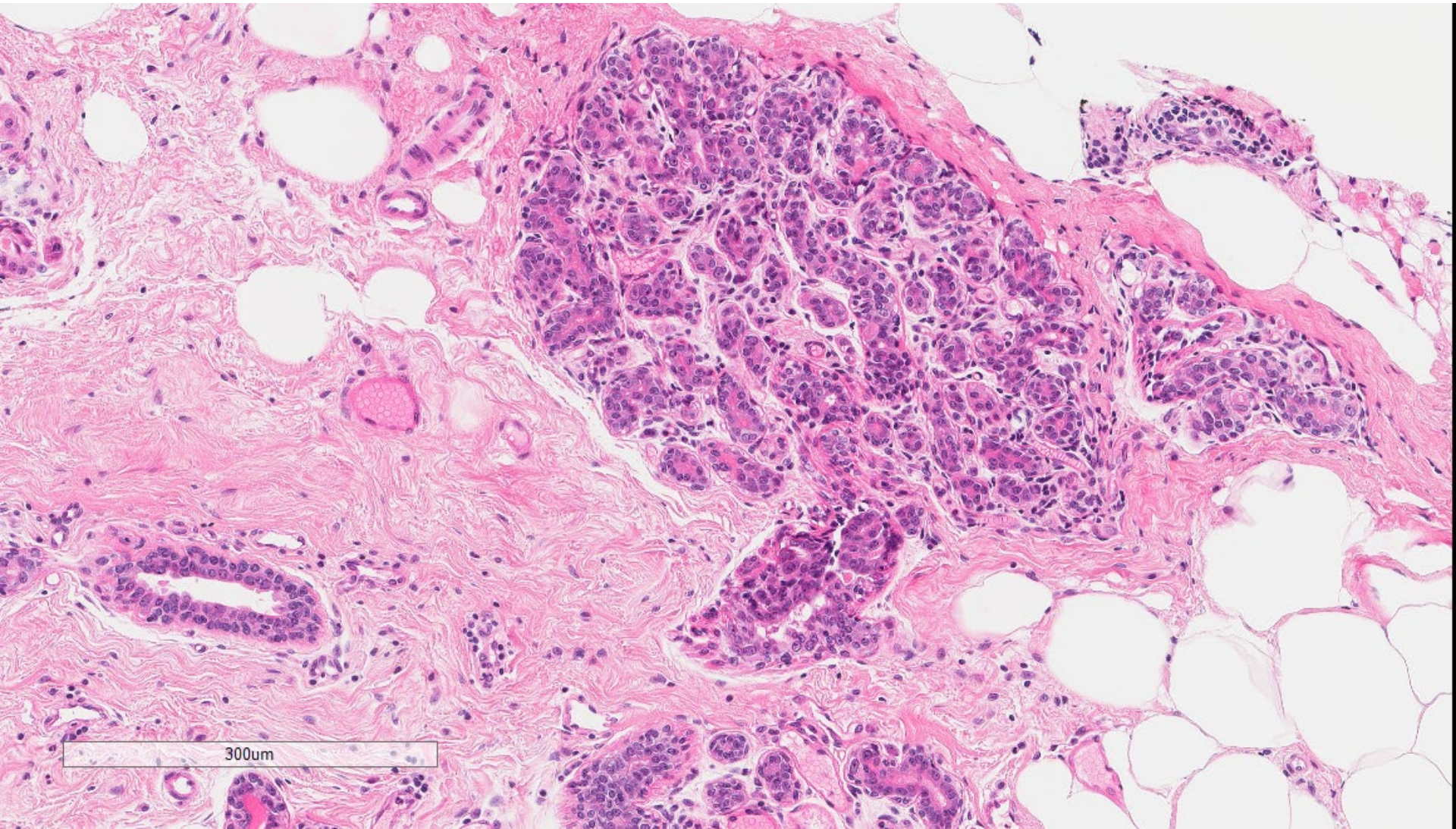




THE FOUR “TYPES” OF TDLU

SCHEDIN

EX10-0218DV-12-TDLU 4-HE-10X-RDC



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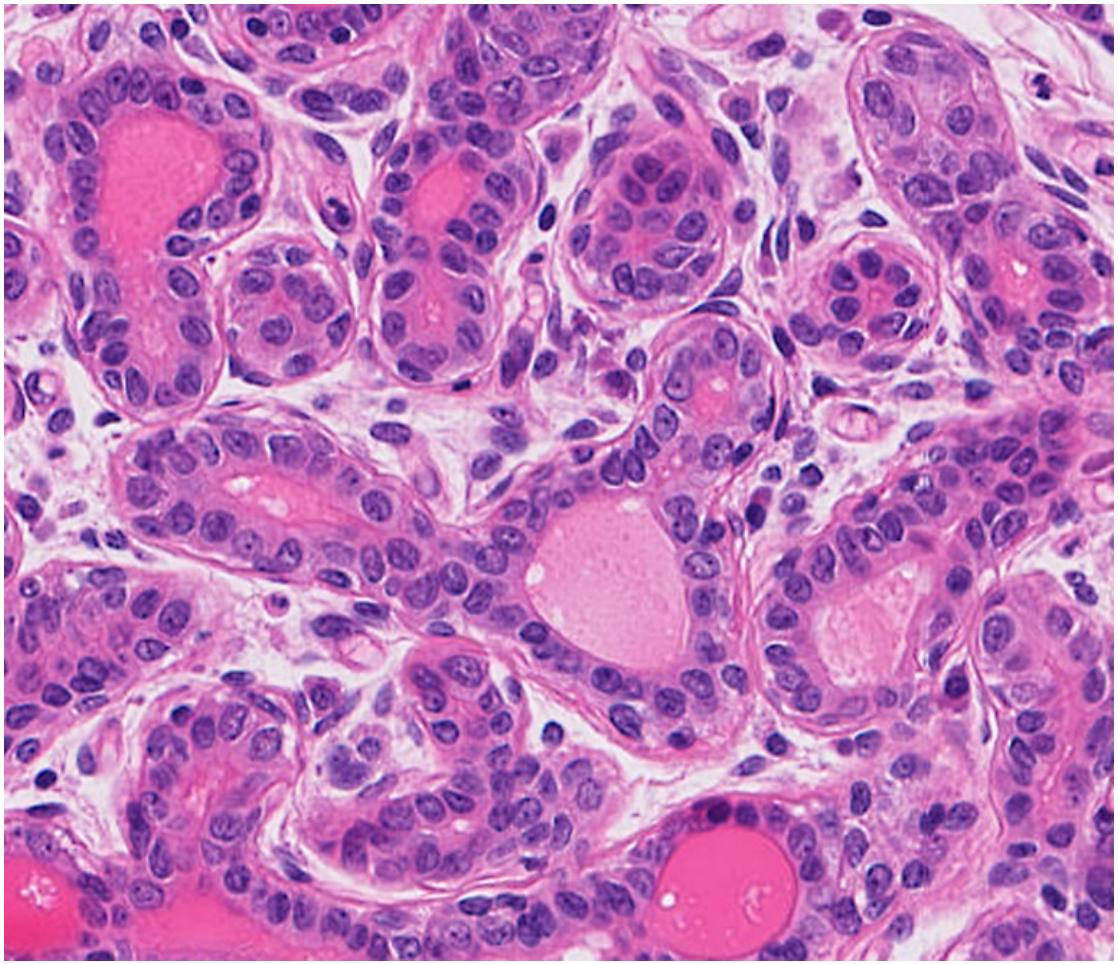
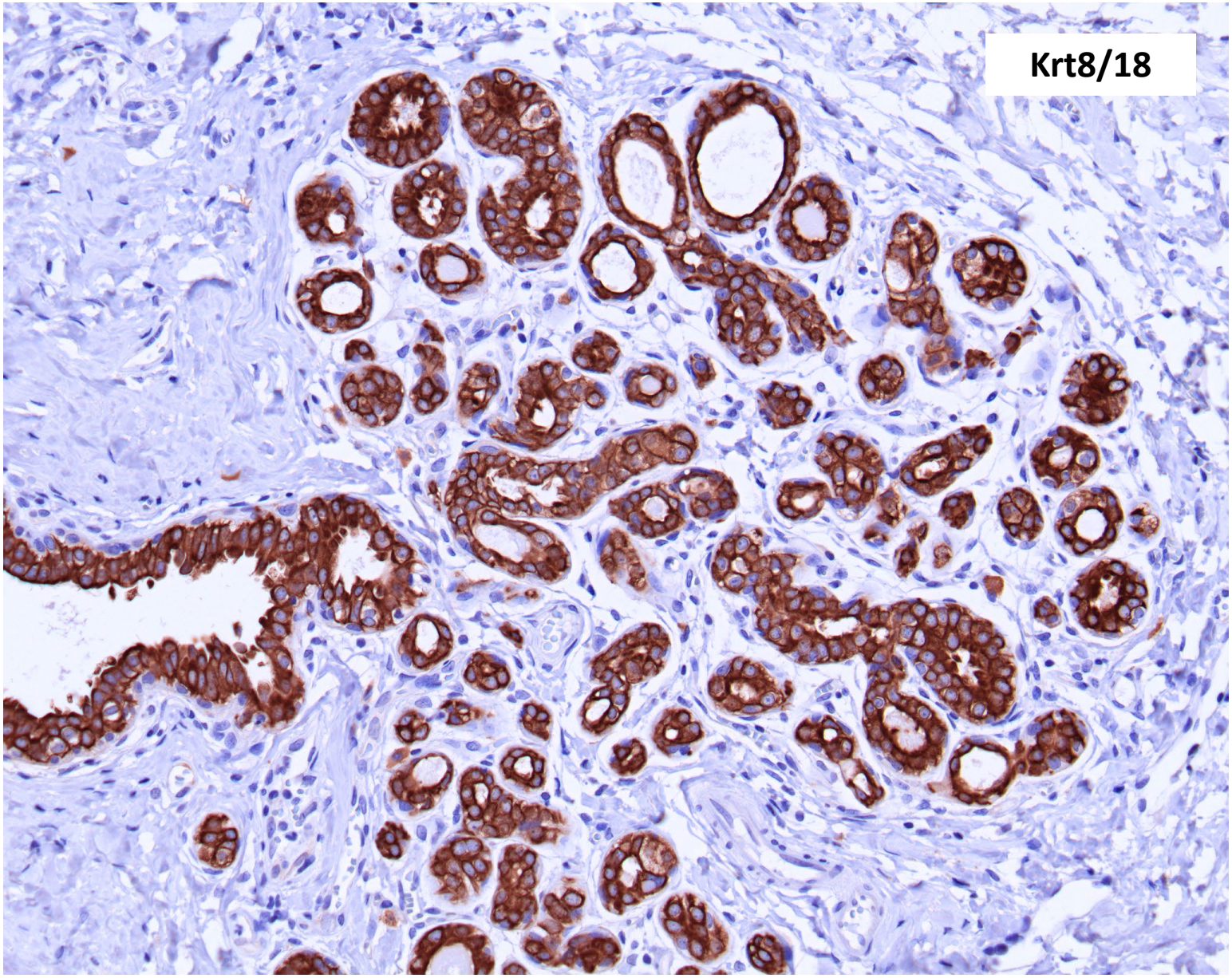
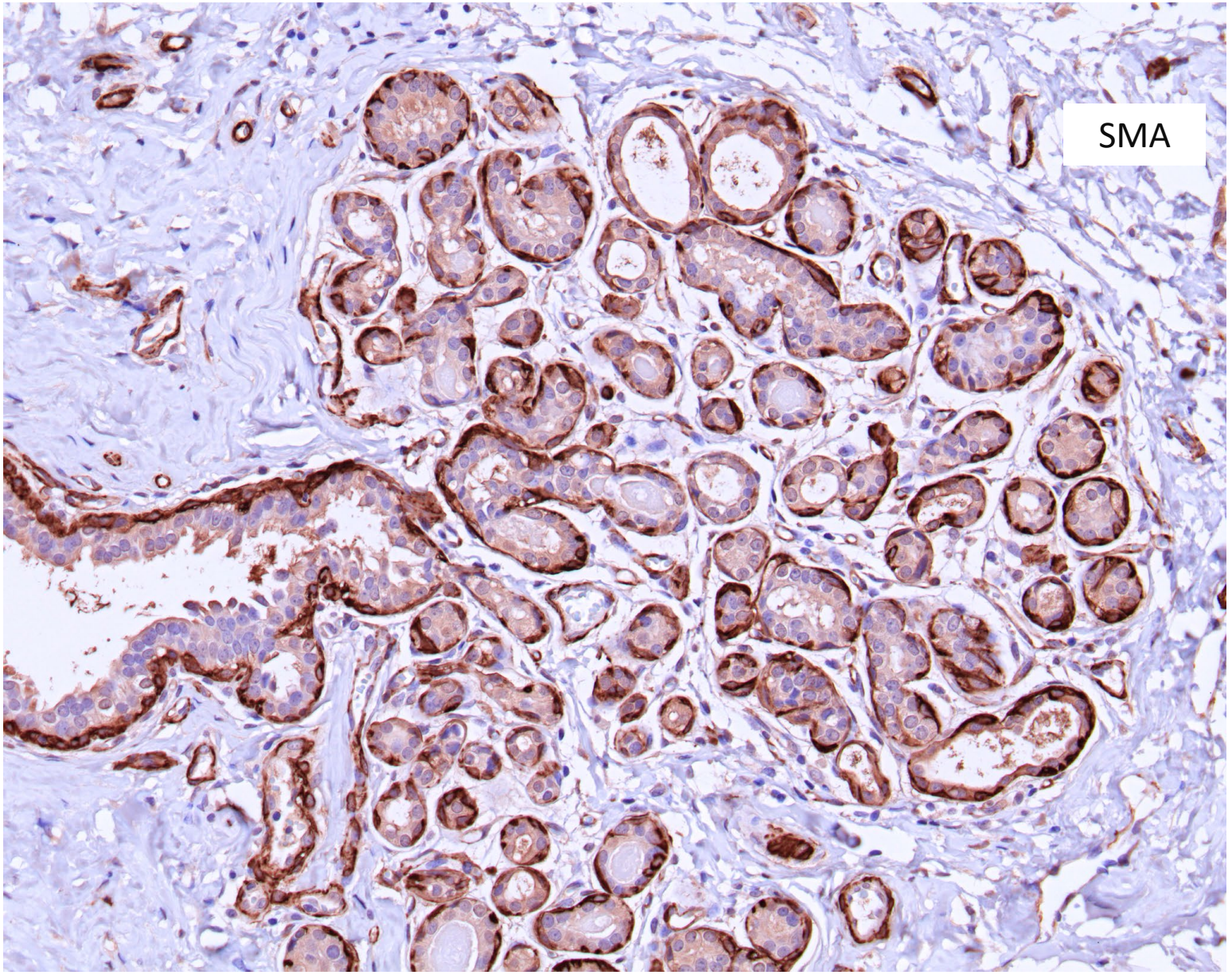
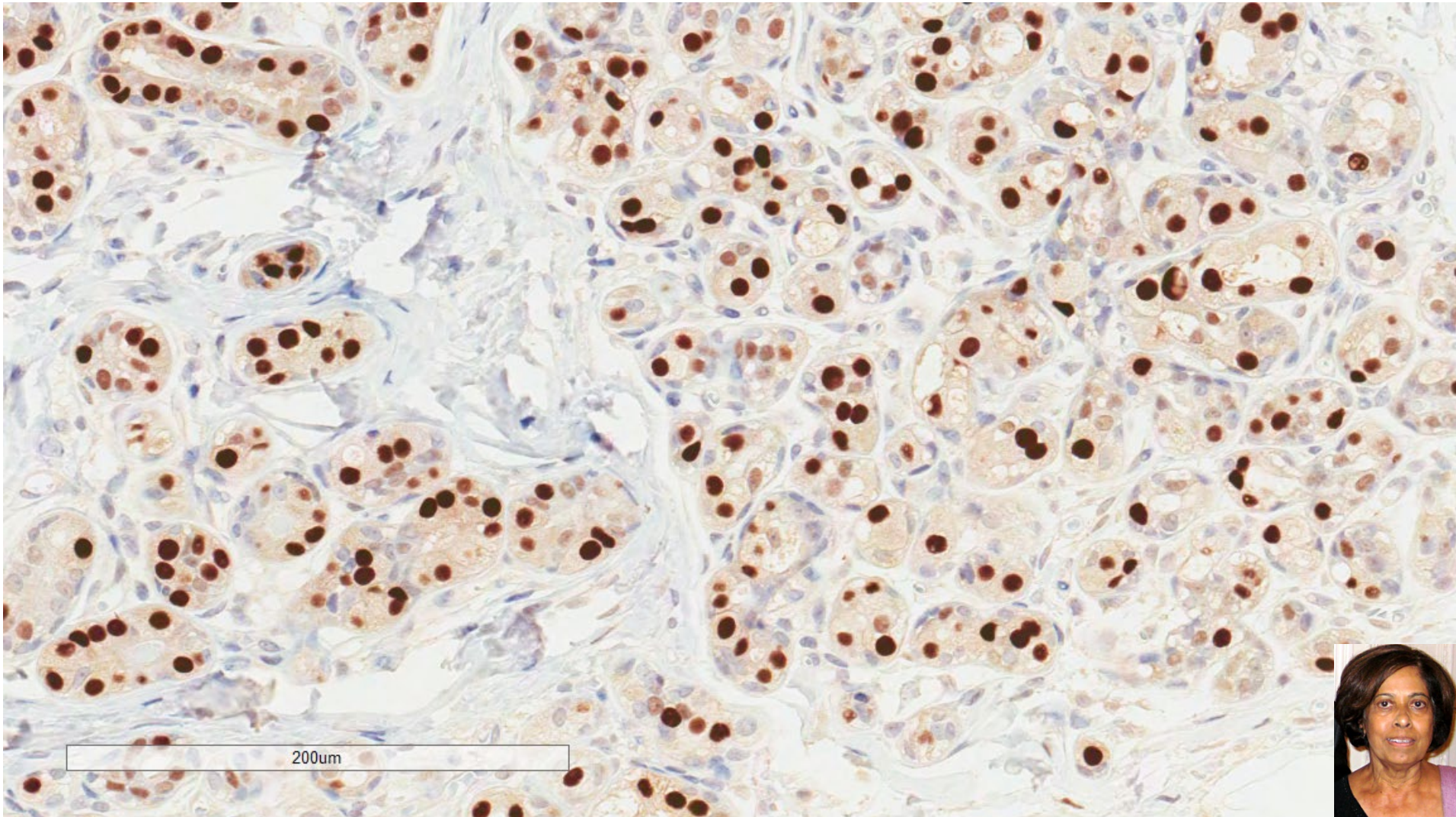



Krt8/18


SMA

EX10-0218DV-3-TDLU1-ER-20X-RDC



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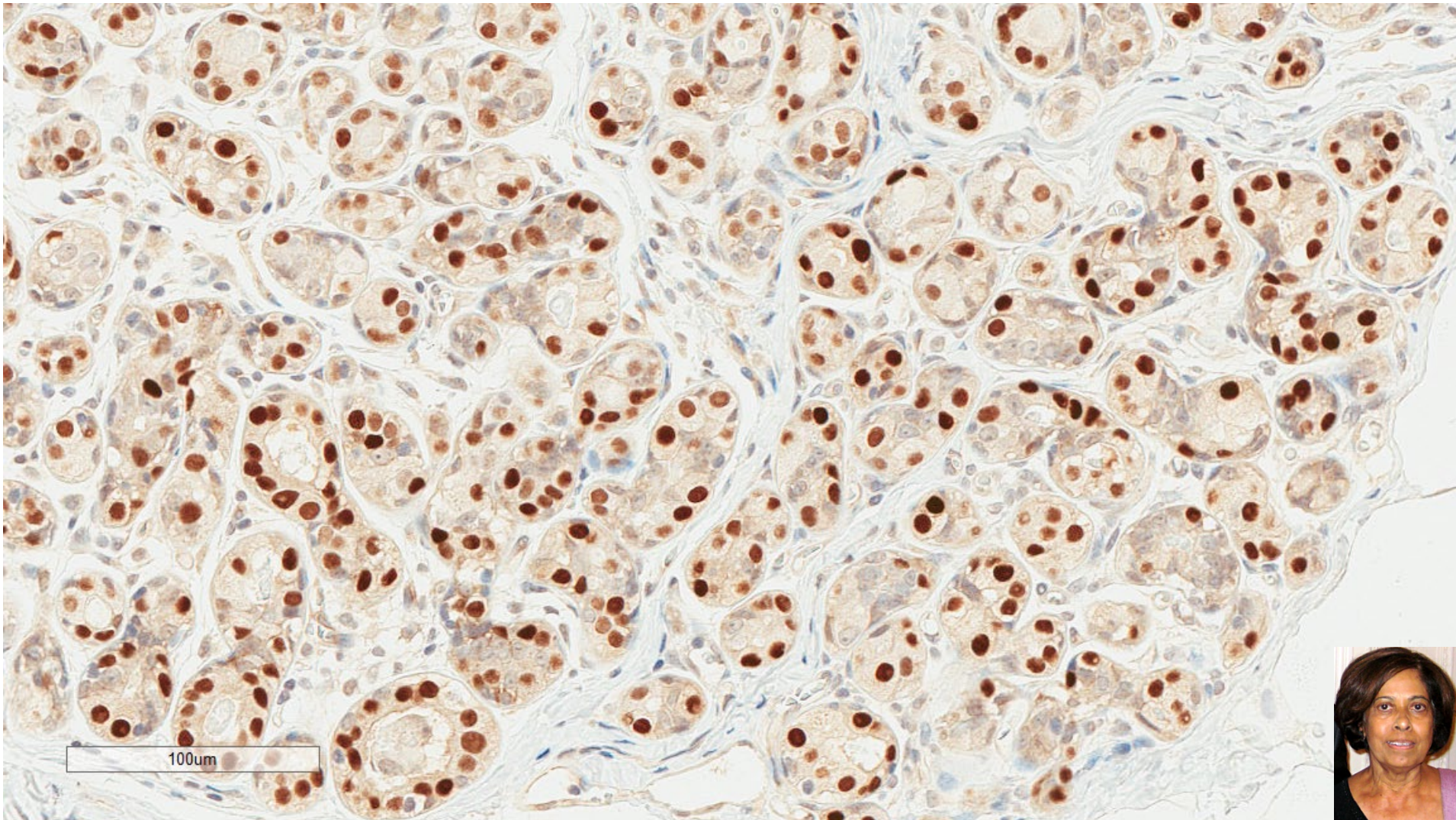

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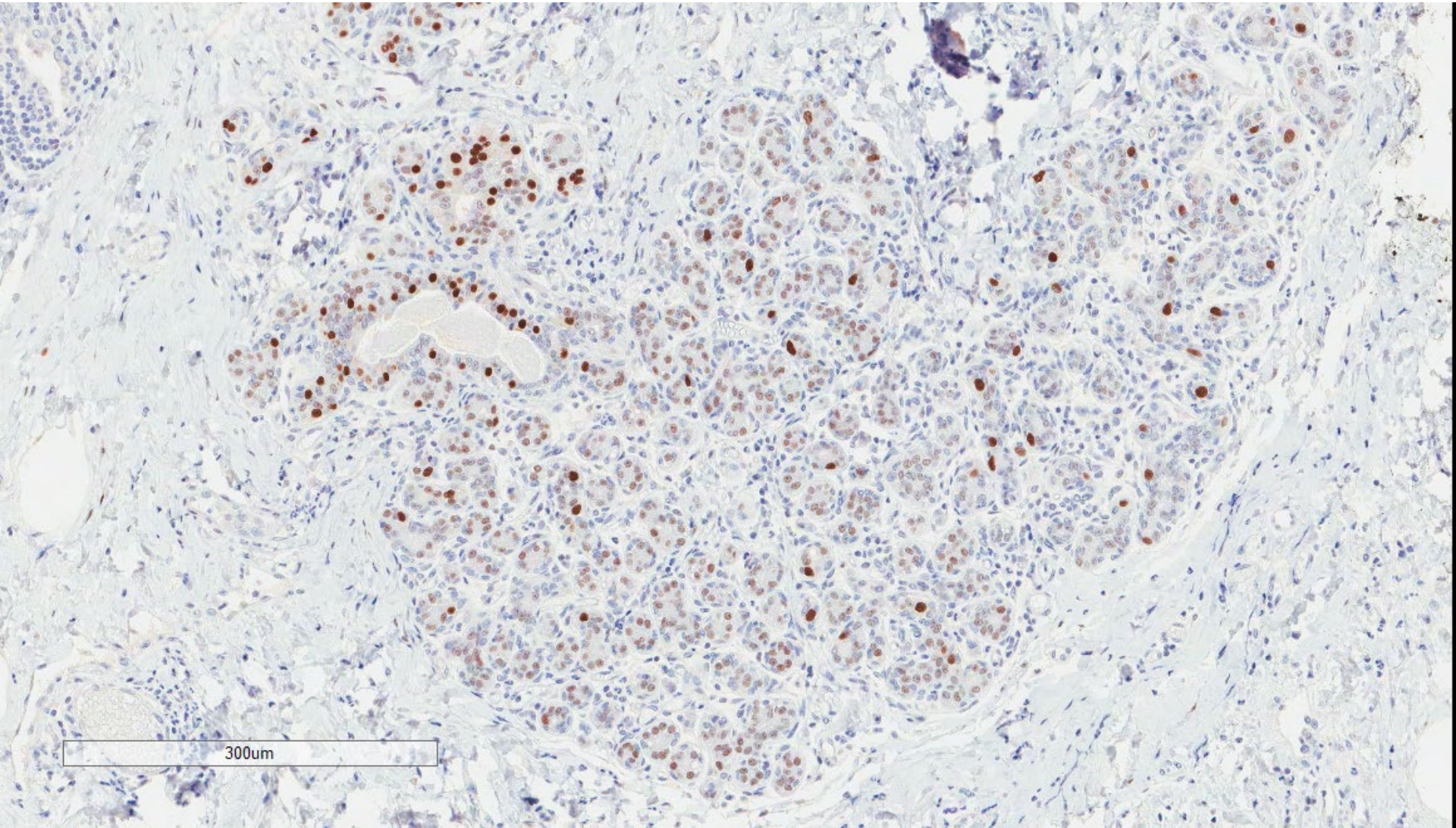
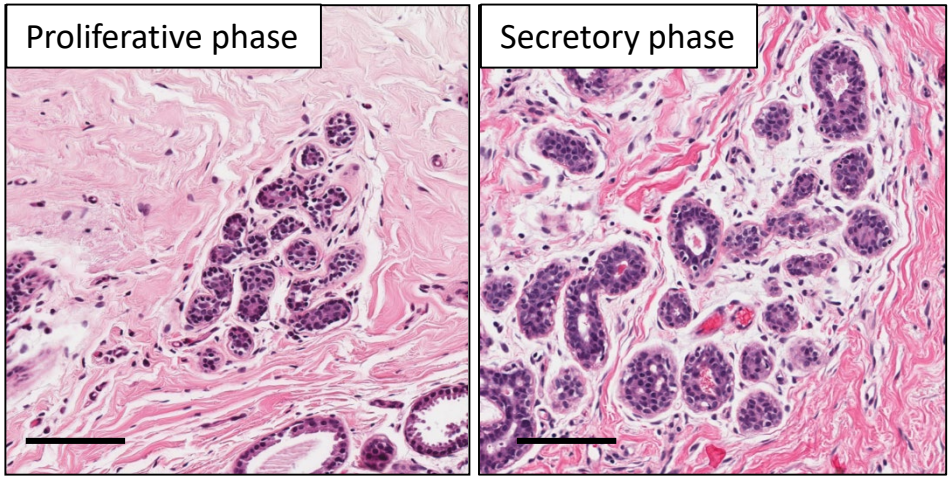


Human Menstrual Cycle



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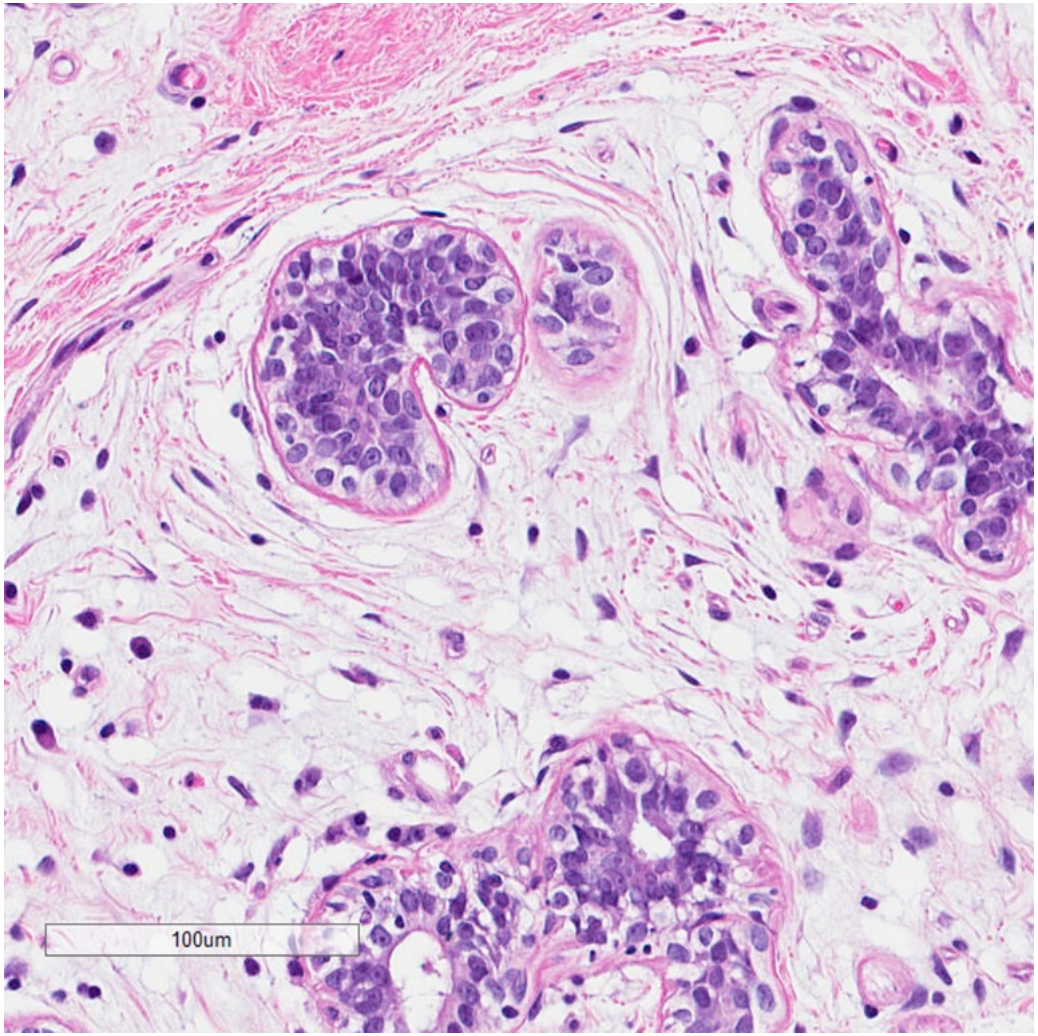

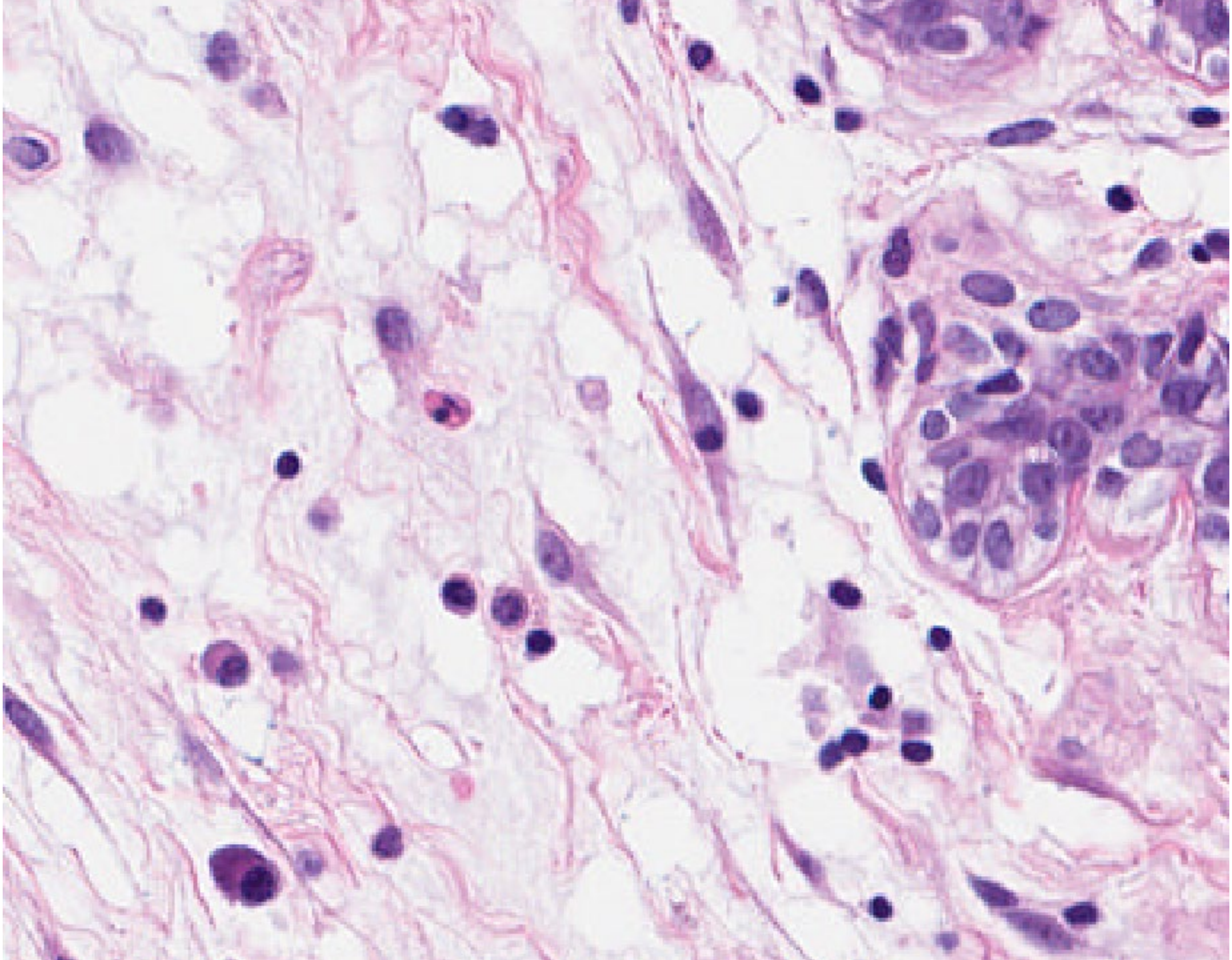

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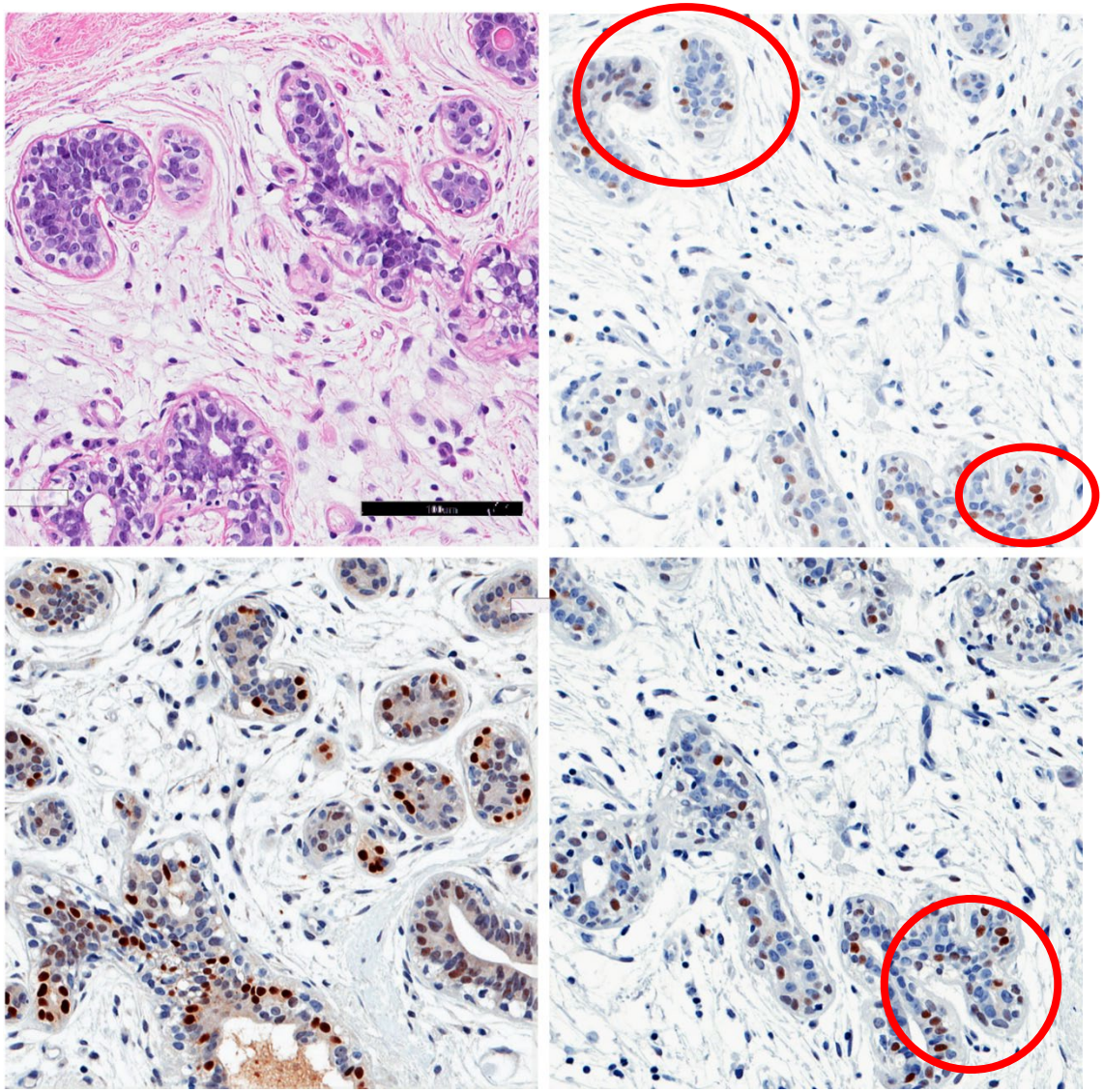

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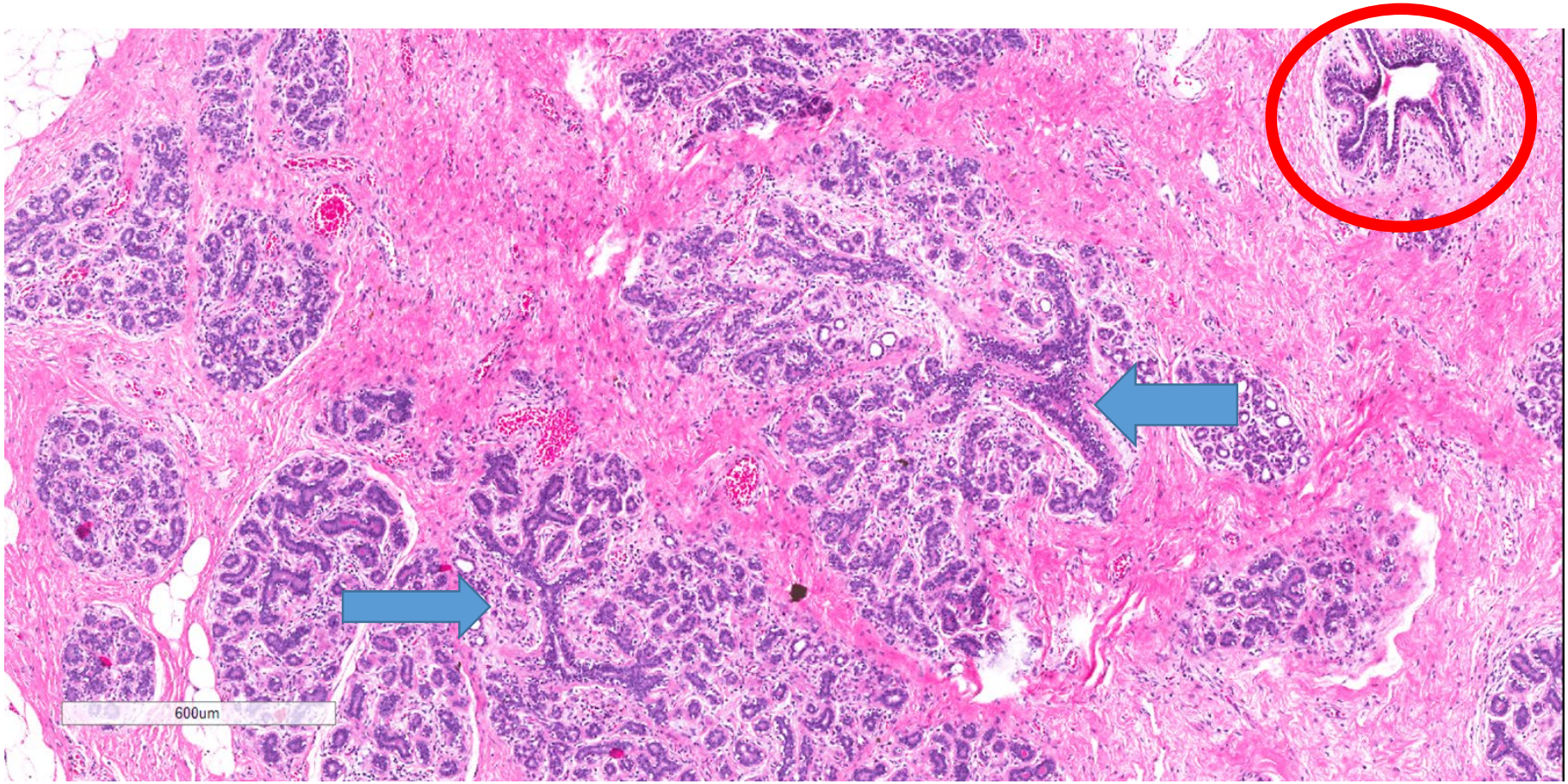

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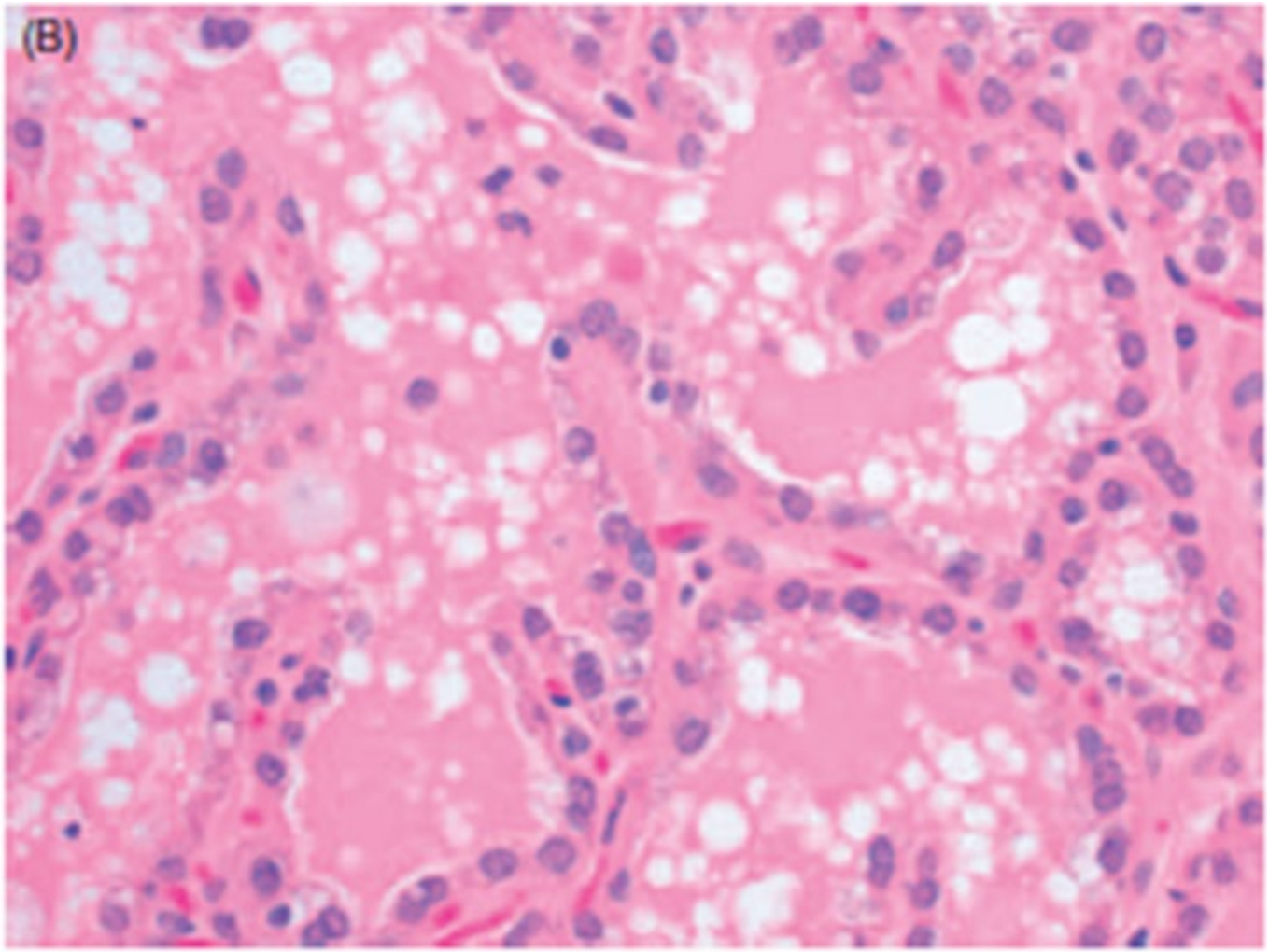


MAMMARY NATURAL HISTORY: Ageing

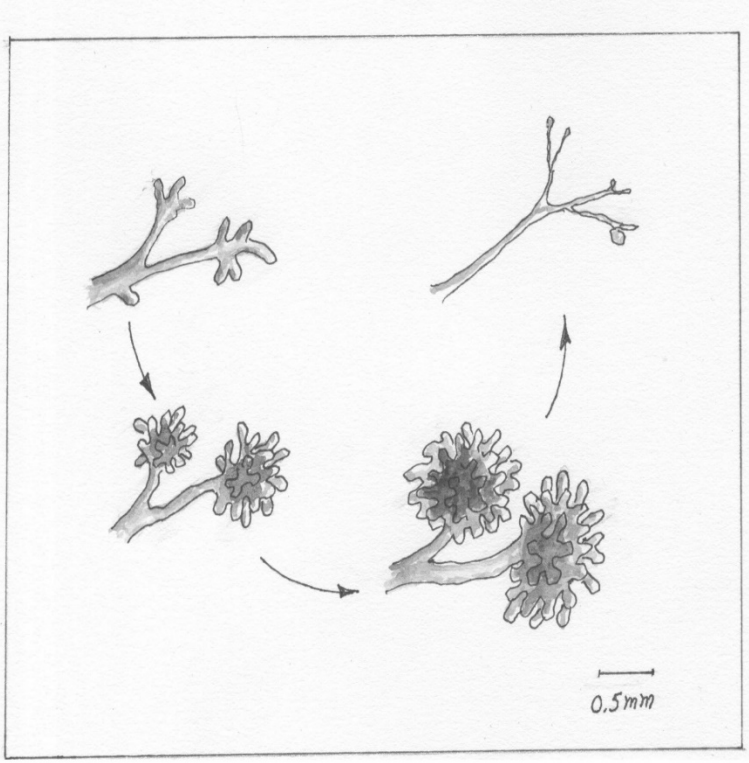
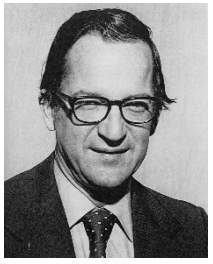


FIGURE 11

Diagram illustrating the natural history of a normal human mammary lobule which progresses from premenarche (upper left) through the reproductive years (bottom left and bottom right), to post-menopausal (senescent) atrophy (upper right).



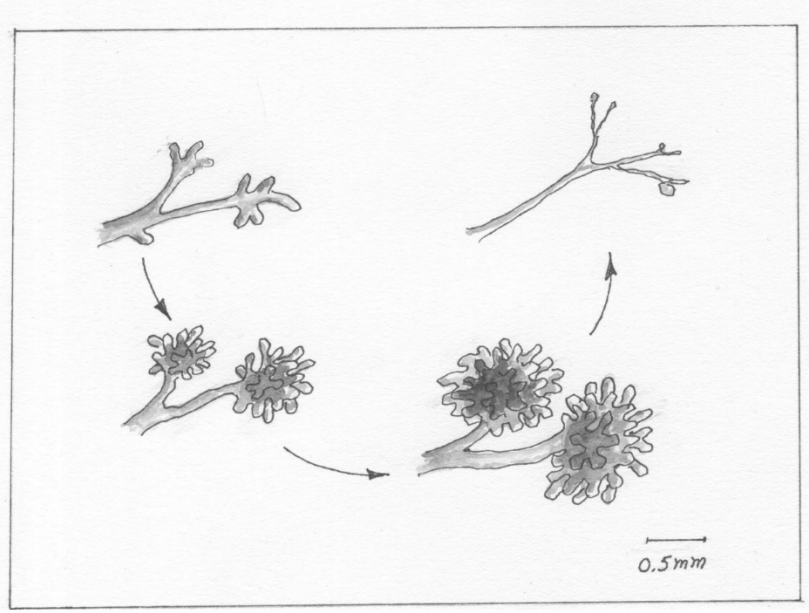
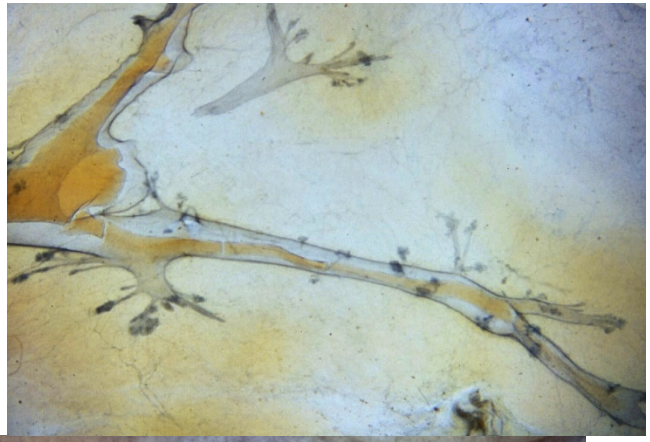


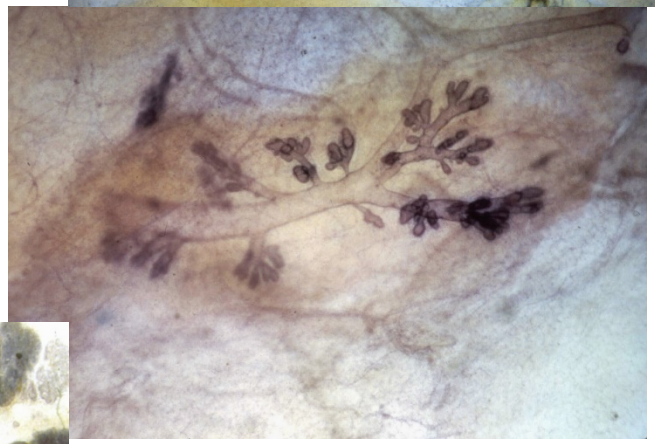
FIGURE 11

Diagram illustrating the natural history of a normal human mammary lobule which progresses from premenarche (upper left) through the reproductive years (bottom left and bottom right), to post-menopausal (senescent) atrophy (upper right).

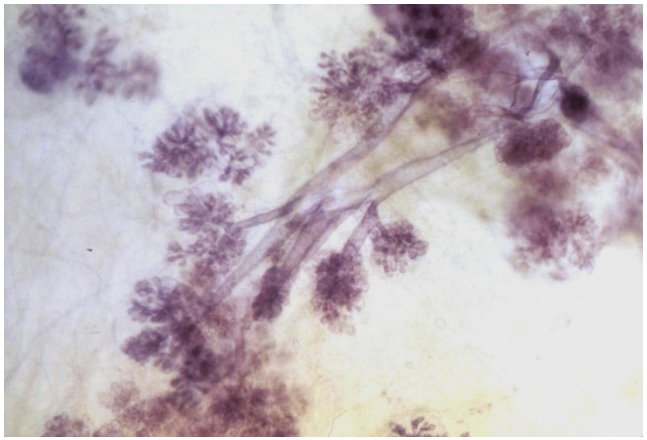
Elderly



Post-menopausal

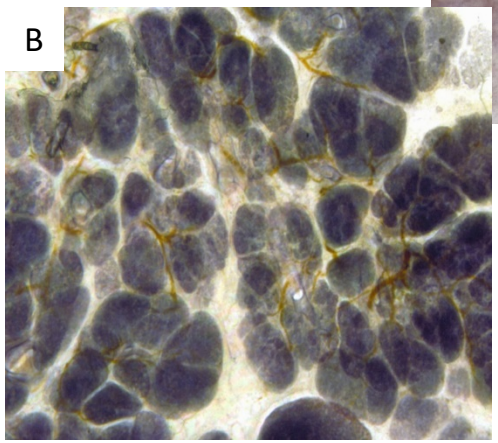


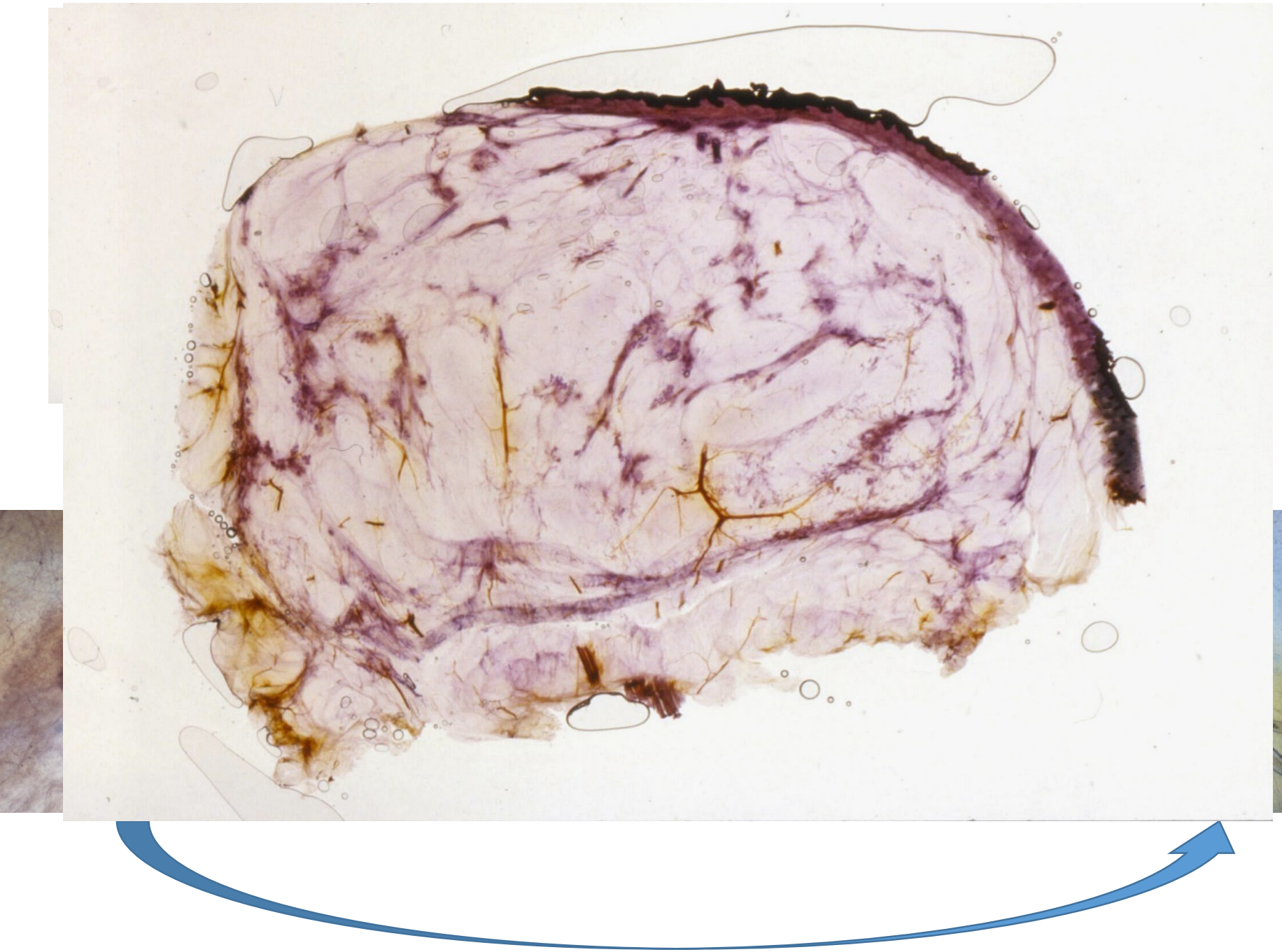
Young Adult

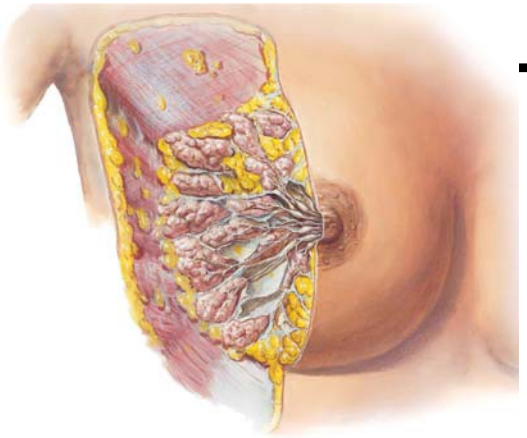


Reproductive

B

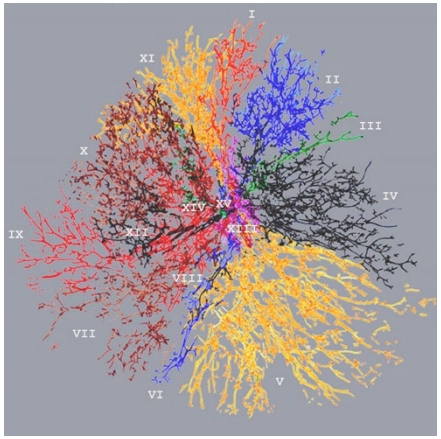


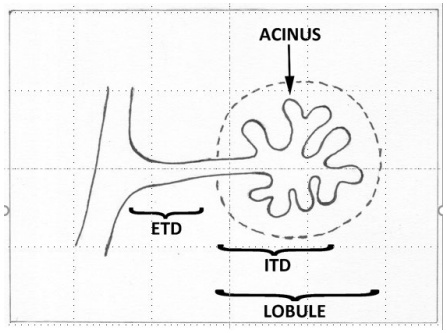


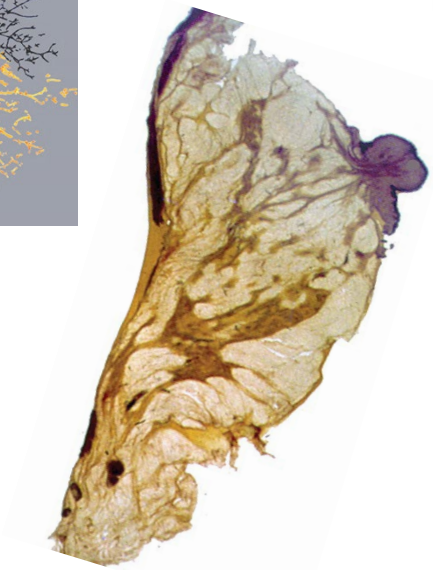


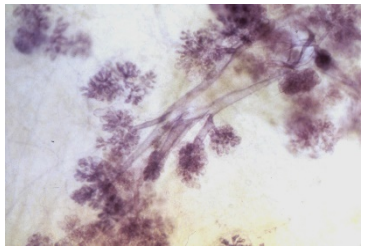
THE HUMAN BREAST

THE INTERMISSION





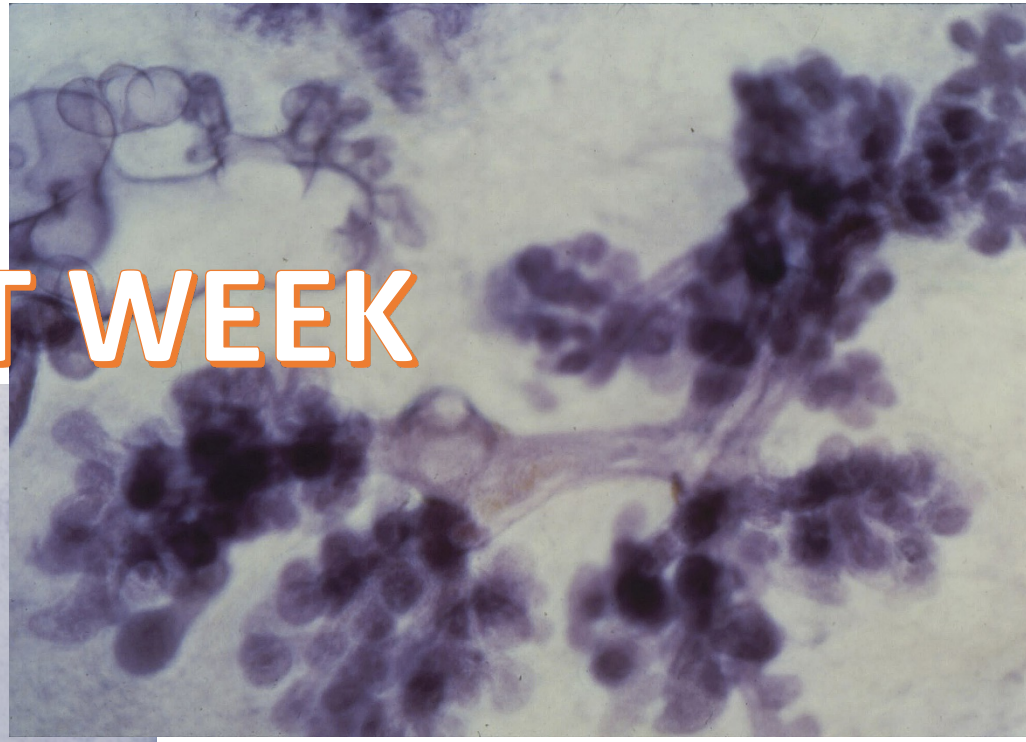


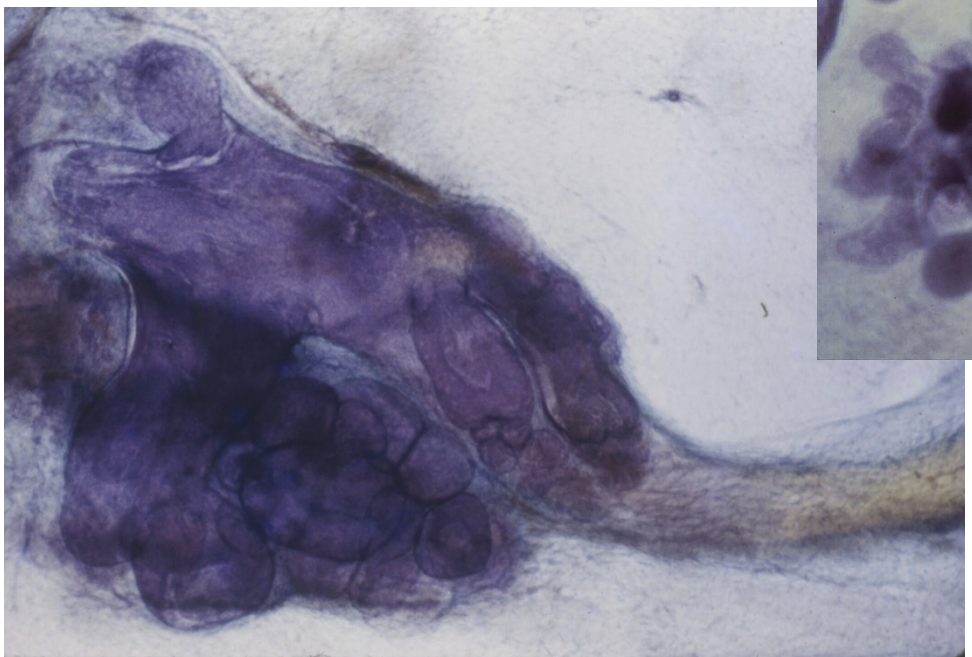


TO BE CONTINUED NEXT WEEK WITH PATHOLOGY

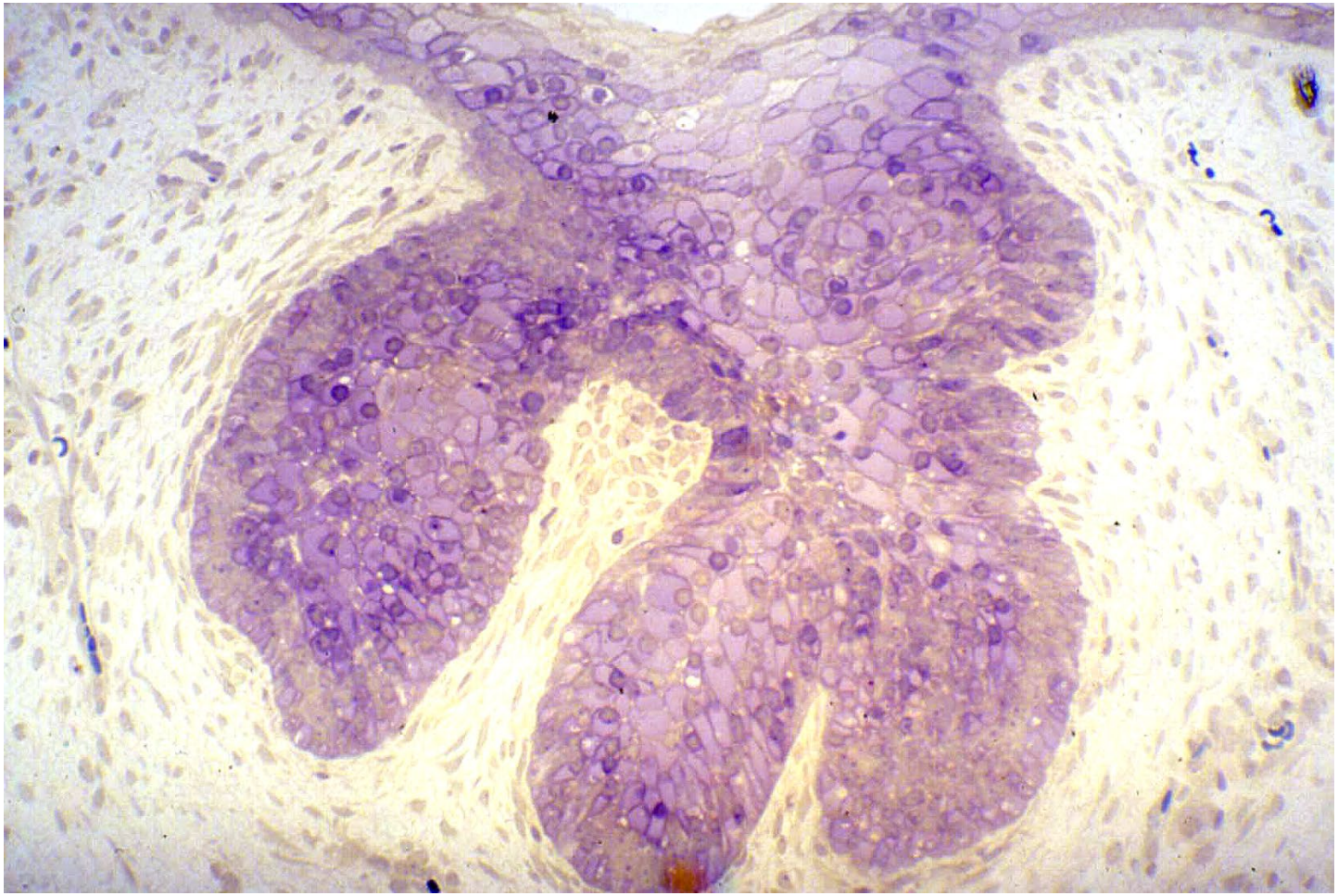
What goes wrong when cells go wrong?

NEXT WEEK

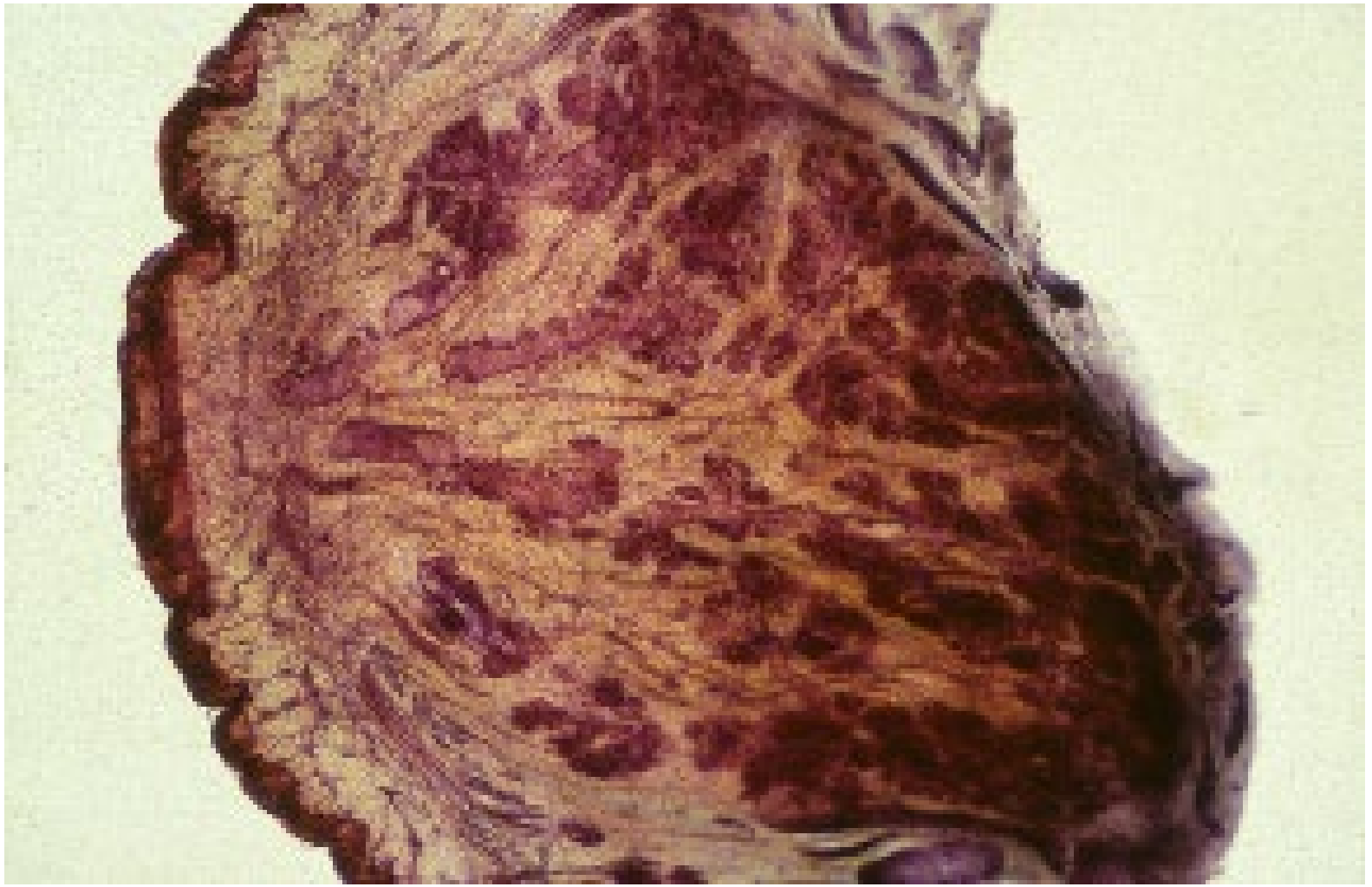




MAMMARY BUD

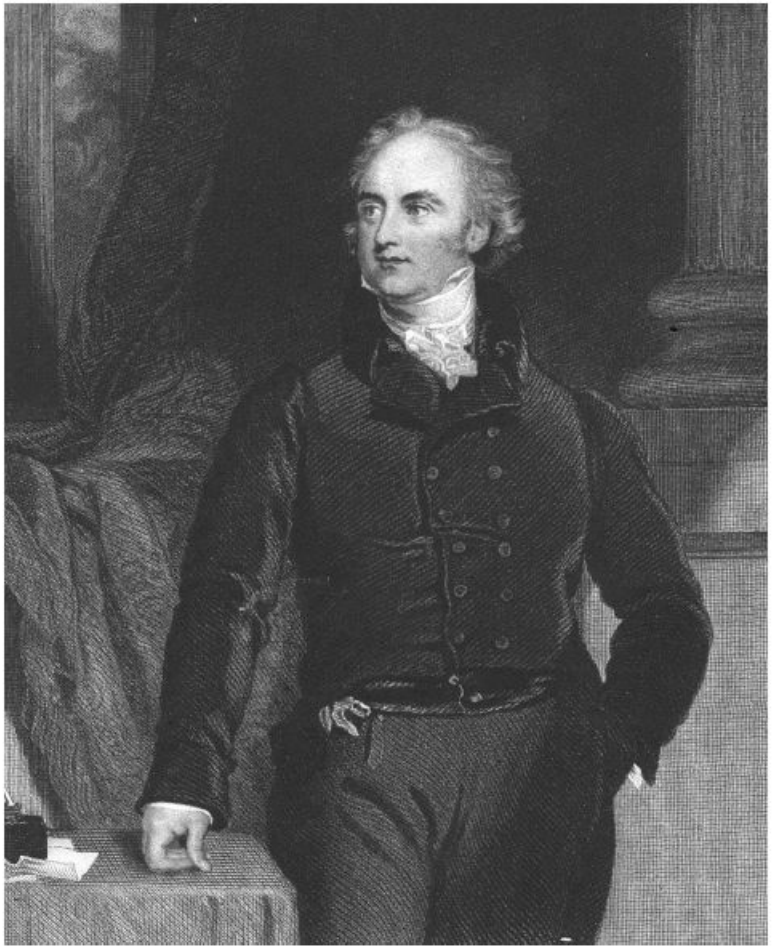


NEW BORN PAPILLAE



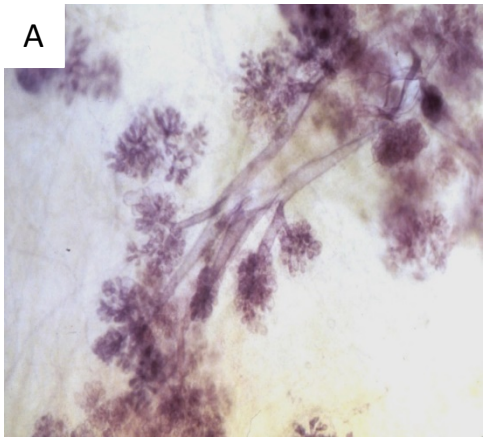
Multiple Ducts

Sir Astley Cooper 1840



Sir Astley Paston Cooper. Steel engraving after the portrait by Sir Thomas Lawrence.

A



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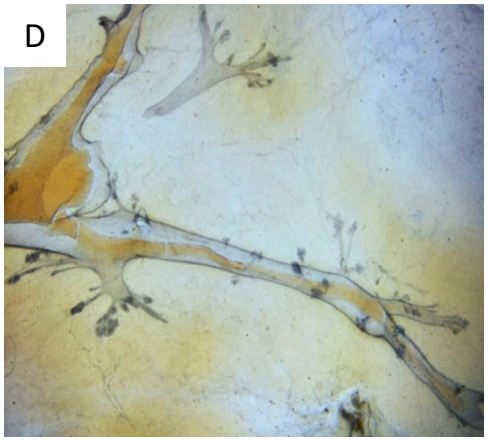
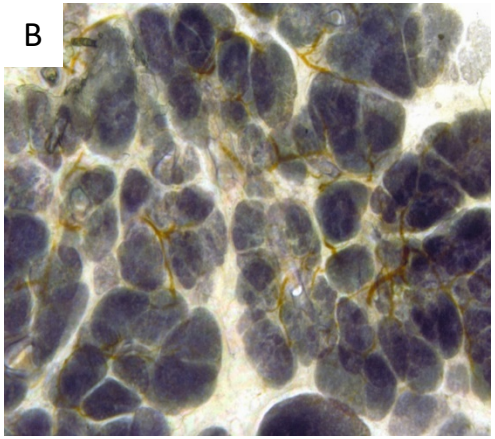


LIFE CYCLE

B



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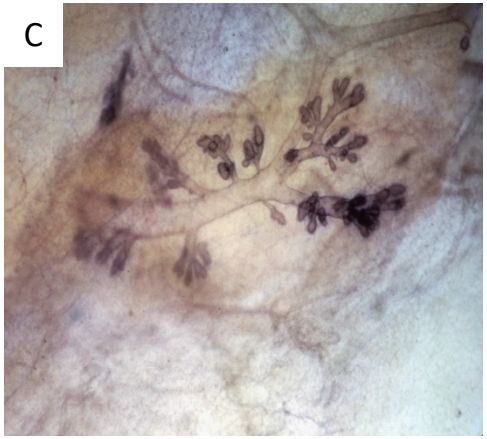
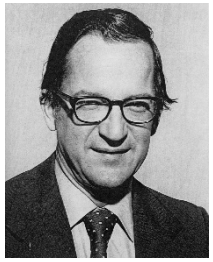
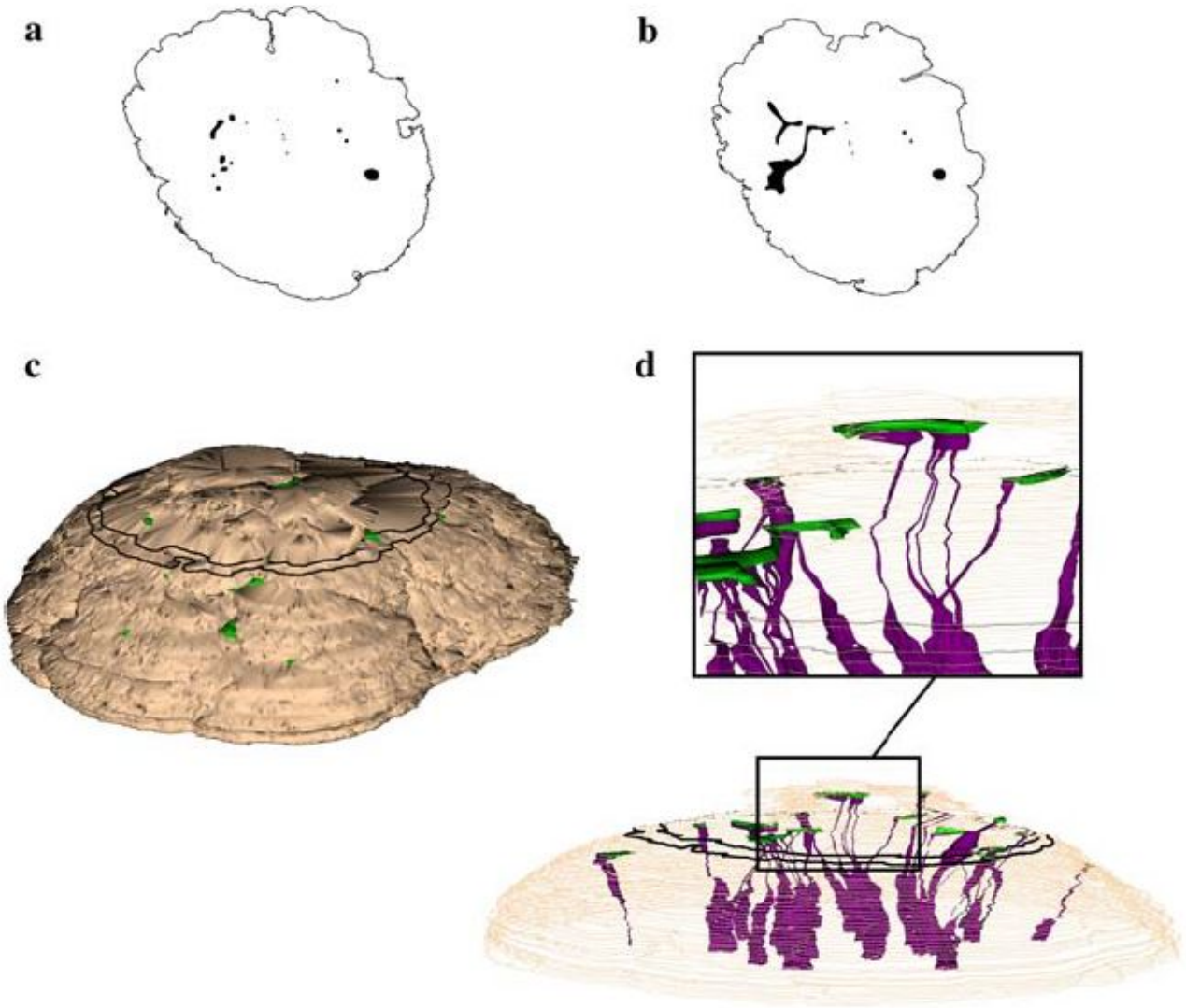




NORMAL HUMAN PRE-PUBERTAL BREAST

NORMAL HUMAN PRE-PUBERTAL BREAST

Rusby et al-Nipple reconstruction



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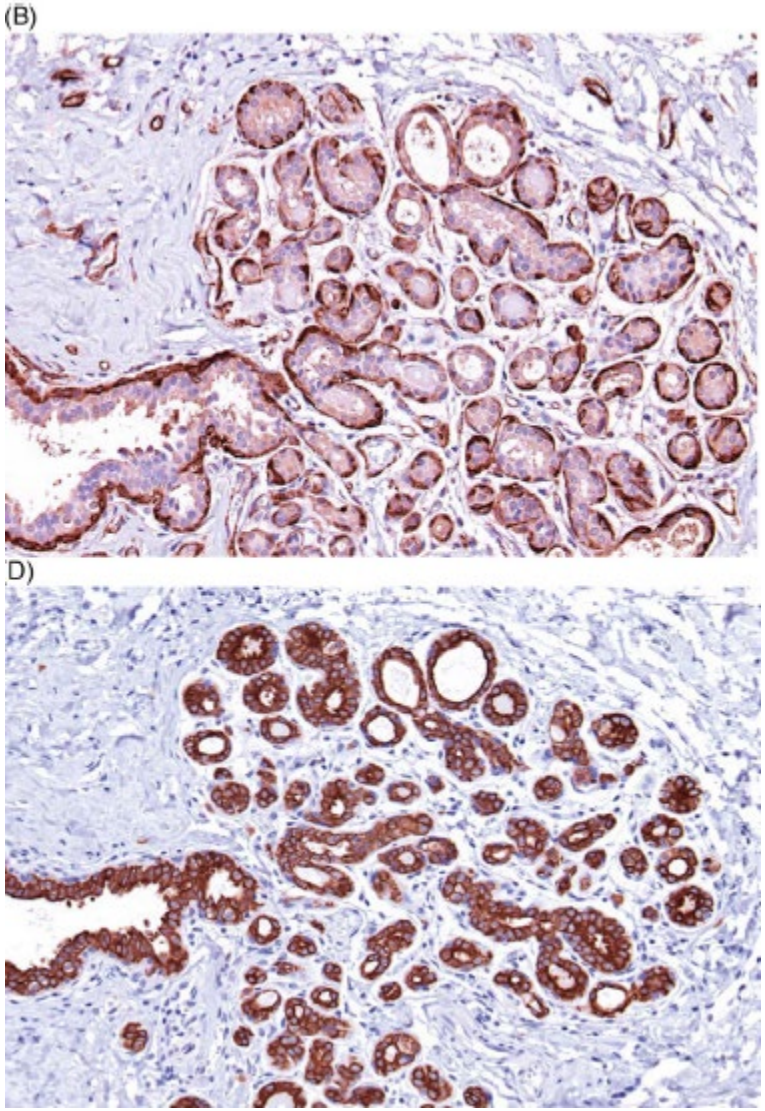

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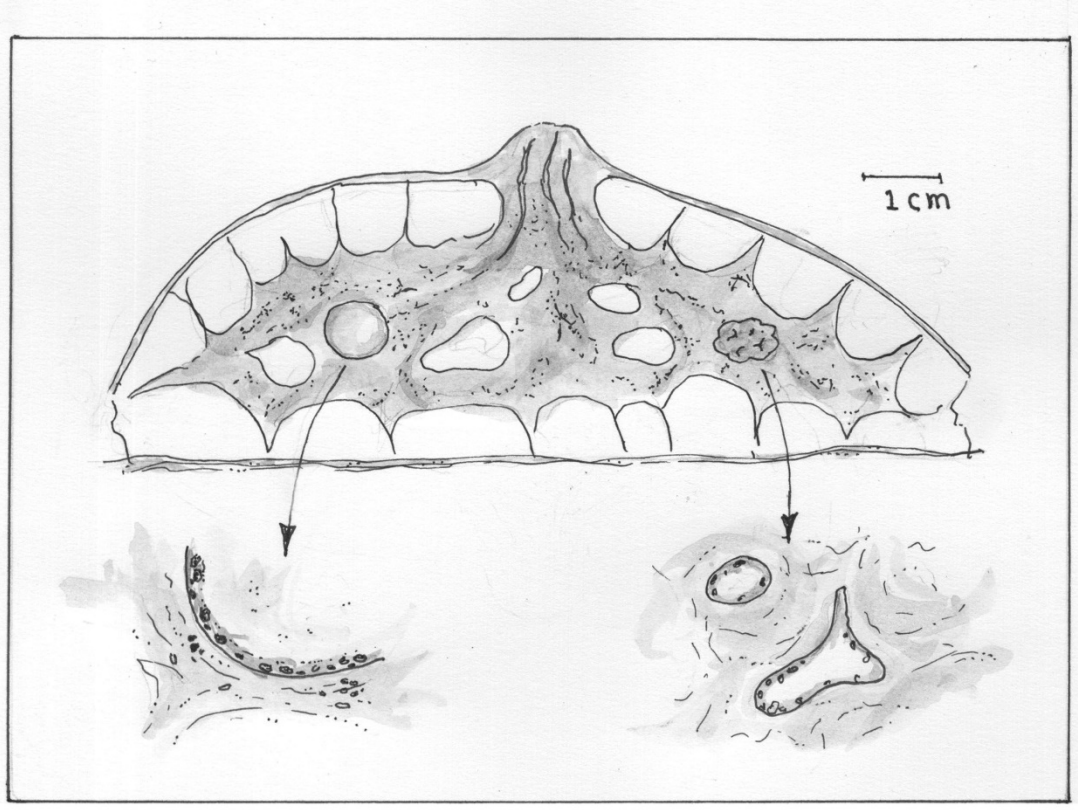
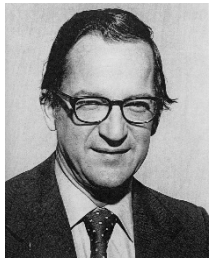
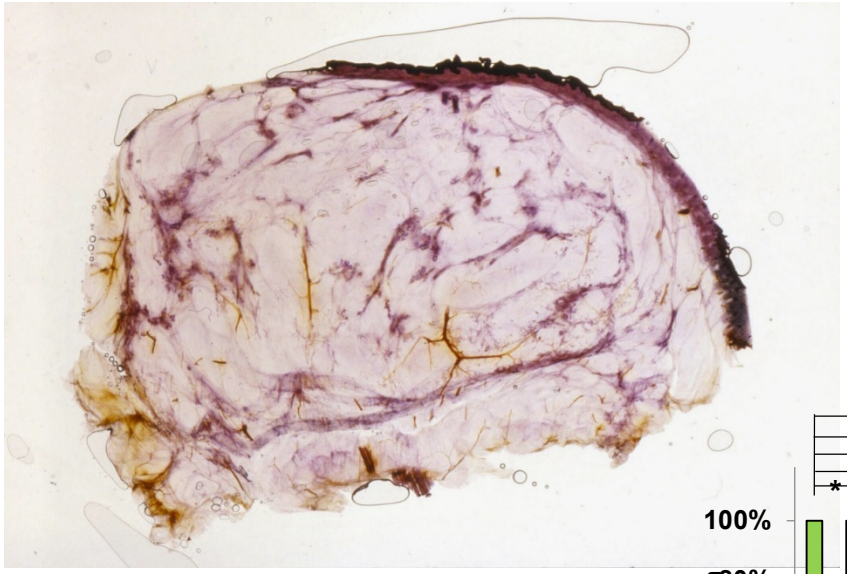


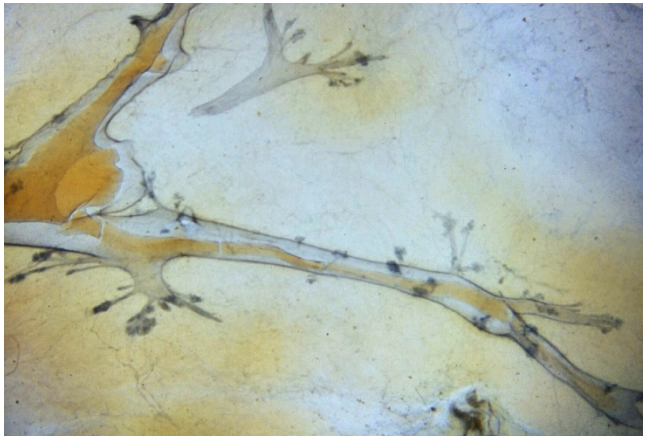
FIGURE 17

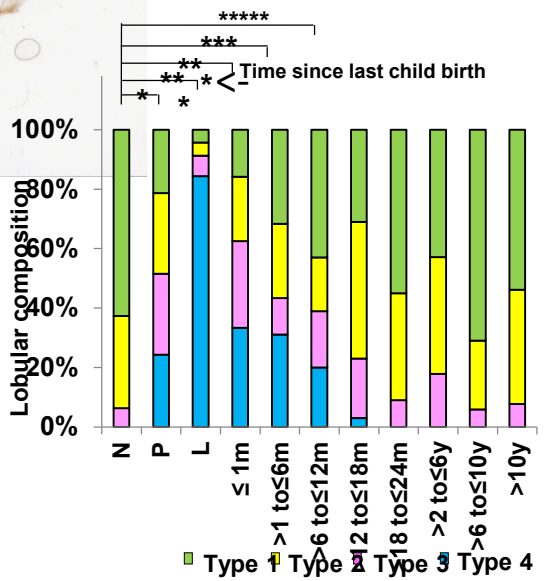
Single slice of human mammary gland, 2-3 mm thick, through the nipple. Grey areas in the drawing are skin, nipple, and mammary layer, which consist mainly of collagen. White areas are adipose tissue. Note subcutaneous and retro-mammary fat layers and lobules of fat in the gray mammary layer. Note the pectoralis fascia below the retro-mammary fat. Note also the epithelial cyst with corresponding histology (left arrow). Note fibroadenoma with corresponding histology (right arrow).



SENESCENCE



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Time since last child birth
100%
80%
60%
40%
20%
0%
Lobular composition
N
P
L
≤ 1m
>1 to≤6m
>6 to≤12m
>12 to≤18m
>18 to≤24m
>2 to≤6y
>6 to≤10y
>10y
Type 1
Type 2
Type 3
Type 4