

1962

Mammography in the diagnosis of the carcinoma of the breast

John Andrew Haggstrom
University of Nebraska Medical Center

This manuscript is historical in nature and may not reflect current medical research and practice. Search [PubMed](#) for current research.

Follow this and additional works at: <https://digitalcommons.unmc.edu/mdtheses>

Recommended Citation

Haggstrom, John Andrew, "Mammography in the diagnosis of the carcinoma of the breast" (1962). *MD Theses*. 2611.

<https://digitalcommons.unmc.edu/mdtheses/2611>

This Thesis is brought to you for free and open access by the Special Collections at DigitalCommons@UNMC. It has been accepted for inclusion in MD Theses by an authorized administrator of DigitalCommons@UNMC. For more information, please contact digitalcommons@unmc.edu.

MAMMOGRAPHY IN THE
DIAGNOSIS OF CARCINOMA OF THE BREAST
A LITERARY REVIEW
AND STUDY OF CASES AT THE
UNIVERSITY HOSPITAL

John A. Haggstrom

Submitted in Partial Fulfillment for the Degree of
Doctor of Medicine

College of Medicine, University of Nebraska

March 15, 1962

Omaha, Nebraska

Thesis

This paper presents a review of the use of plain mammography in the diagnosis of carcinoma of the breast including a survey of its application in the University Hospital.

TABLE OF CONTENTS .

Introduction.	1
Historical Development.	1
Plain Roentgenography of the Breast	
Techniques of Study.	3
Normal Roentgenographic Anatomy.	5
Findings in Carcinoma.	7
Critical Evaluation	
Diagnostic Accuracy.	8
Role in Routine Cancer Detection.	9
Results with Plain Mammography at the University Hospital.	10
Discussion.	11
Summary.	13
Conclusions.	14

MAMMOGRAPHY IN THE
DIAGNOSIS OF CARCINOMA OF THE BREAST
A LITERARY REVIEW
AND STUDY OF CASES AT THE
UNIVERSITY HOSPITAL

Introduction

In the hands of the particularly qualified radiologist, plain mammography has been shown to be a useful and accurate means of diagnosis of carcinoma of the breast. However it has received only limited clinical application, as its use has been largely limited to that of a special diagnostic technique.

Failure of a more widespread and routine application of mammography can probably be explained on the basis of three factors: (1) failure of the attending physician to recognize its value, (2) failure of many radiologists to become adept in its application and interpretation, and (3) expense. The problem is thus essentially one of further education of the medical profession in its use and application. Cost should remain a minor factor in view of benefits of early and accurate diagnosis of breast malignancies.

Historical Development

The first application of plain mammography to the diagnosis of mammary carcinoma was made by the German surgeon, Salomon (1), in 1913. In an effort to study the extent and mode of spread of mammary

cancer in order to obtain more adequate biopsy specimens, he studied 3,000 mastectomy specimens correlating the roentgenographic findings with the gross and microscopic features of the tumors. His work contained a wealth of information which, though not immediately applied clinically, has had a great impact on subsequent investigations.

Salomon demonstrated that mammograms could be used to delineate the margins and extent of a tumor. In one of his illustrations note is made of tiny calcific densities at the center of an infiltrating tumor, an important diagnostic point which was overlooked until nearly forty years later. He was able to differentiate between scirrhous and nodular forms of breast cancers. He also reported the first "clinically occult" breast cancer to be found by roentgen examination.

Following Salomon's publication little was contributed to this subject until the 1930s during which period numerous papers appeared. In 1931 Goyanes, Gentil, and Guedes (2) presented a preliminary report on roentgenography of the breast as a new method of diagnosis. Other reports from the European literature appeared from a group in Leipzig (3, 4) under the auspices of Payr.

In 1930 Warren (5) made the first important contribution to the American literature. Using stereoscopic films of the breast, he reported a high degree of correlation between the roentgenographic diagnosis and the findings at operation or autopsy. Numerous contributions to the knowledge of the roentgenographic findings in all physiologic phases and pathologic states of the breast came from Seabold (6,8), Reimann and Seabold (9), Lockwood (10, 11) Lockwood and Stewart (12), Gershon-Cohen and Strickler (13), Hunt and Hicken (14) to mention but a few who contributed significantly.

Except for technical advances little of significance appeared from this time until 1951 when Leborgne (15) reported the finding of peculiar calcifications in mammary carcinomas as an important diagnostic sign.

Plain Roentgenography of the Breast

Technics of Study

The roentgenographic technics utilized in the study of the breast are designed to produce films of maximum soft tissue contrast and detail covering as much of the breast area as practical. Lane and Pendergass (16) have reviewed technics utilized prior to 1947.

Presently tangential, preferably taken in the upright position with the x-ray beam passing through the breast in a cranio-caudad direction, and lateral or oblique views passing through the base of the breast are commonly utilized. Egan (17) has recently recommended the addition of an axillary view for more complete evaluation of the tail of the breast and the axillary lymph nodes. Various devices for compression of the breast have been suggested, none of which are uniformly employed. Spot films of suspicious areas also are of value.

The technical factors vary according to equipment available. Cardboard filmholders are generally used. Standard x-ray film has been employed, however recently Egan (17) suggests the use of "Kodak Industrial M" film for better details. Other factors commonly employed with standard film are (1) a focal distance of 30 to 40 inches, (2) 200 to 300 milliamperes, (3) 20 to 30 kilovolts, and (4) an exposure time of 2 to 3 seconds.

Again it should be pointed out that the above factors are variable in different hands and require a large degree of individualization. Special supervision and personnel experienced in the technics utilized should result in optimum quality roentgeno-

grams of the breast.

Normal Roentgenographic Anatomy (Fig. 1 & 2)

The breast is suited for roentgenography by virtue of the contrast existing between the radiolucent fatty tissue surrounding the corpus mammae which is relatively radiopaque. Leborgne (18) distinguishes three separate regions of the breast roentgenographically: (1) the gland, (2) the adipose tissue and (3) the cutaneous covering.

(1) The Gland-Corpus Mammae: roentgenographically the corpus mammae has the shape of an irregular triangle being more developed on the axillary side. The contour of the gland is free and irregular except at its vertex where it converges and adheres to the nipple.

The corpus mammae is constituted by fibrous stroma and the glandular elements. It presents great morphologic variations depending on the somatic constitution and period of sexual activity.

The gland undergoes cyclic changes during the menstrual cycle. Lockwood and Steward (12) demonstrated a slight decrease in the sharpness of detail of the fatty constituents of the breast 4 to 5 days before menstruation. This is on the basis of a hazy frond-like accentuation of glandular and ductal pattern

of the breast.

The breast also undergoes marked changes during gestation and lactation. Ingleby, Moore and Gershon-Cohen (19) have studied these changes by serial x-rays. The marked proliferation and distention of the breast nearly obliterates the normal breast features making studies of pathologic changes during this period grossly inaccurate.

During adolescence the breast gradually develops into the opaque clearly defined gland of young women. After the menopause, the gland atrophies, is infiltrated by fat, dissociates and gradually disappears, being replaced by fatty tissue.

(2) Adipose Tissue: The adipose forms the translucent element which surrounds and infiltrates the corpus mammae. Its quantity varies with the age, functional state and constitutional type of the individual breast. It forms the radiolucent premammary and retromammary zones described by Lockwood (20).

(3) The Cutaneous Covering: The dermic and epidermic thickness of the breast is represented by a radiopaque line approximately one millimeter thick. It is attached to the underlying breasts by the suspensory ligaments. The areolar area may be demonstrated as an area of decreased radiolucency.

Findings in Carcinoma (Fig. 3-9)

Gershon-Cohen and Ingleby (21) have summarized the primary and secondary diagnostic x-ray criteria of malignancy as follows:

Primary Criteria:

(1) The size of the tumor is less in the film than that determined by palpation.

(2) The radiopacity of a malignant tumor is apt to be greater than that of the surrounding tissues; and the more fat a breast, the greater is the difference in contrast between the tumor and perifocal tissue. They also confirm the presence of punctate calcifications in and around many malignant tumors.

(3) The margins of a malignant tumor are irregular, tentacled and spiculated.

(4) The perifocal tissues in the tumor bed of a malignant growth are blurred and distorted.

Secondary Criteria:

(1) Alterations in the position of the nipple.

(2) Local or diffuse thickening of the skin, sometimes with retraction.

(3) Accentuation of the trabeculae, especially if the malignant process is diffuse or widely spread.

(4) Increased vascularity in the parenchyma and in the subcutaneous fat layer.

The calcifications seen in malignant neoplasms of the mammary gland deserve special comment. Leborgne (15) describes them as follows: "scattering.....of punctate calcifications resembling fine grains of salt....in and surrounding the nodule." This finding is practically pathognomonic of carcinoma, however it must be differentiated from coarser types of calcification found in benign conditions, including fibroadenoma, fibrocystic disease, and vascular and ductal calcification. Leborgne reported this finding in approximately 30% of his cases, however Egan (17) found them to be present in 47% of 245 cases in his series.

Critical Evaluation

Diagnostic Accuracy

Warren (5) in 1930 reported an accuracy of 85% to 95% present in diagnosis of breast malignancies in a select series of 119 cases, thirty-three of which were obvious advanced cases of malignancy. Egan (17) reported a diagnostic error of 0.83% in 240 cases of

malignant lesions found in 1000 consecutive mammograms at the M. D. Anderson Hospital and Tumor Institute. In his series 20 cases out of 182 proven benign at biopsy were diagnosed as malignant. Five cases of malignant disease which had excisional biopsies prior to mammography were reported negative. Study of surgical specimens in these cases showed no residual neoplasm.

Gershon-Cohn, Hermel and Berger (22) correctly diagnosed malignant lesions in 22 of 23 proven cases indicating a high degree of accuracy though only a small sample.

Role in Routine Cancer Detection

Gershon-Cohen, Hermel and Berger (22) report a five year study of the use of mammography at six month intervals for purpose of cancer detection in 1312 women who were symptom free at the time of first examination. Breasts were examined clinically after the initial exam and prior to subsequent x-ray examinations. Of these women 256 dropped out of the series after one or more examinations. They report a case finding rate of 17.5 per 1000. Of the 24 malignant lesions, 6 were not clinically palpable. At operation 16 of these 24 patients were free of axillary metastasis.

This compares to a case finding rate of 6.1 per

1000 at the Cancer Detection Center of the University of Minnesota (23) over an eleven year period in women over 45 years of age, and a 3.8 per 1000 case finding rate in a three year survey at the Strang Cancer Prevention Clinic in New York without use of mammography. In the University of Minnesota, 71% of cases diagnosed were free of axillary metastasis, while 50% at the Strang Cancer Prevention Clinic were found to have axillary metastasis.

Gershon-Cohen and others feel these results point to the value of routine use of mammography in cancer detection. However it should be noted that the case finding rate in his series was near 13 per 1000 cases on clinical examination alone, pointing to a significant difference in the population sampled.

Results with Plain Mammography at the University Hospital

During the period from November 21, 1960 to February 8, 1962 plain mammography was performed on 51 patients at the University Hospital. Of these patients 14 were not included in the study due to inadequate data. A total of 76 mammograms were done on the 37 patients included in the study. Each examination consisted of lateral or oblique and a tangential view of the breast with the exception of 8 cases where only single views were obtained.

The results are as follows:

	Total	Roentgenographically		
		Benign	Negative	Malignant
Malignant lesion	18	2	5	11
Benign lesion; biopsy	8	5	2	1
No lesion; biopsy	1		1	
Benign lesion; no biopsy	9	8		1
No lesion; no biopsy	40		40	
Total	76	15	48	13

Discussion

A diagnostic accuracy of 61% was obtained with plain mammography in the present series of 18 cases of malignant lesions of the breast. In one case the diagnosis was missed on the first examination, but was demonstrated on a repeat examination. Review of the original films in this case revealed the lesion to be present at that time. No lesions were demonstrable in the remainder of malignant cases which were reported as benign or negative.

Mammography was instituted at the University Hospital as a part of the teaching program for the radiologic staff. At the onset it was recognized that the procedure would be of limited value due to the lack of experience of the attending staff. No claims were made for the accuracy of the procedure.

The analysis of the present series points to a lack of proficiency in the techniques presently employed. Pathologic data available on the cases is insufficient to analyze for possible sources of error. This would be of great value in aiding the radiologist to improve his proficiency.

The radiographic technique used at the University Hospital has shown improvement as experience has been gained by the technicians. The value of films which adequately include the base of the breast should be emphasized. The addition of an axillary view to each examination would be of value as indicated by Egan (17).

The ability of the attending radiologists to diagnose cancer of the breast by mammography is limited as indicated by the present series. The small series available for study and lack of adequate pathologic data are a severe handicap in gaining a high degree of proficiency with the procedure. Specialized training in this technique would seem desirable if a high

degree of competence is to be gained.

Egan (25) has instituted a five day training course for radiologists at the University of Texas M. D. Anderson Hospital and Tumor Institute in an effort to teach radiologists his technique. Presently a cooperative study is being carried out with eighteen radiologists trained by Egan to determine if his results can be reproduced. The results of this study will be an aid in evaluating what can be expected from this technique in the future.

Summary

Plain mammography has received only limited application in the diagnosis of carcinoma of the breast. Recently a high degree of accuracy has been demonstrated for this technique in the hands of one highly qualified radiologist. It has been shown to be of value in the detection of clinically occult lesions of the breast. Advocates for the routine use of mammography in cancer detection have been gained.

The techniques of study and the diagnostic criteria for cancer of the breast with plain mammography have been established. The training of the radiologist in their application must be obtained if a high degree of accuracy is to be attained.

A study of the mammograms performed at the University Hospital reveals a diagnostic accuracy of 61 per cent in 18 cases of malignancy. Adequate analysis of factors leading to errors could not be made due to limited data available regarding these cases. Suggestions for improvement are made.

Conclusions

1. The diagnosis of carcinoma of the breast can be established with a high degree of accuracy with plain mammography in the hands of the particularly qualified radiologist.
2. A diagnostic accuracy of 61 per cent was obtained in 18 cases of cancer of the breast studied at the University Hospital.
3. Adequate coverage of the breast by the mammograms must be made for accurate interpretation.
4. Special training of the radiologist is necessary for proficiency in the interpretation of mammograms.

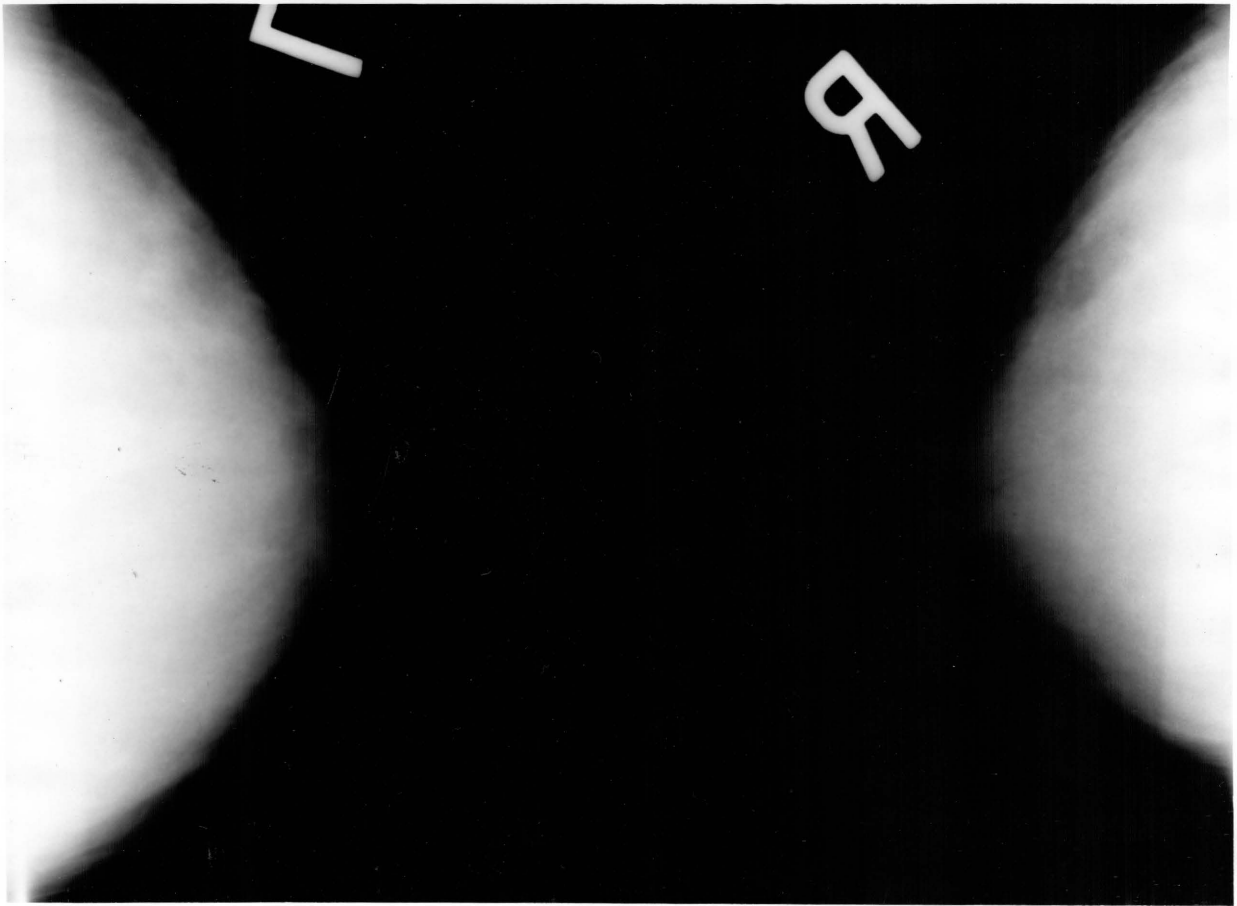


Fig. 1. Normal breasts, female, age 19. (Lateral views) Prominent, opaque corpus mammae with scanty adipose tissue make the visualization of pathologic conditions difficult.

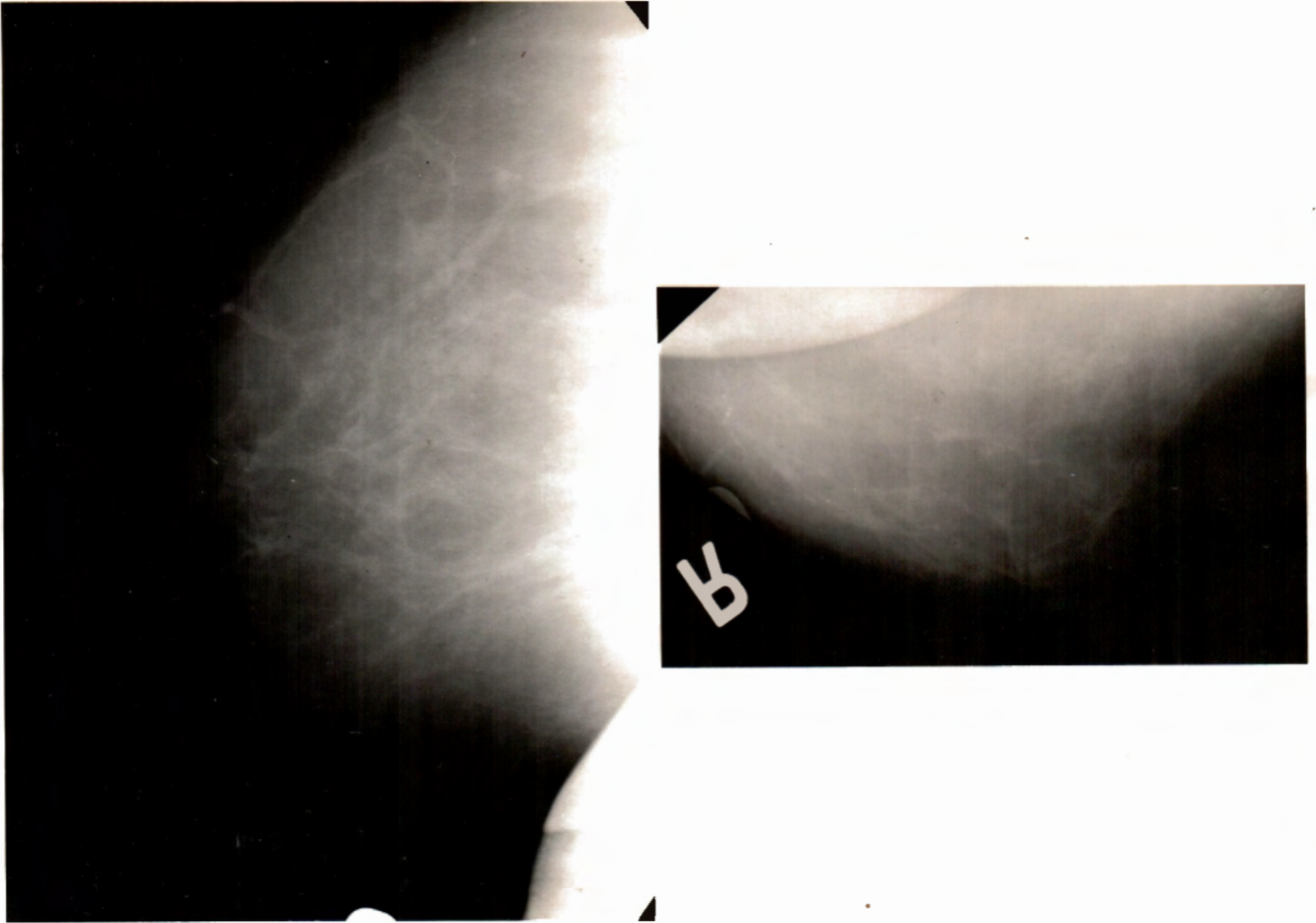


Fig. 2. Normal breast, female, age 64. (Lateral and cranio-caudal view) The corpus mamma has practically disappeared with only a network of fibrous strands and a few vessels visualized.

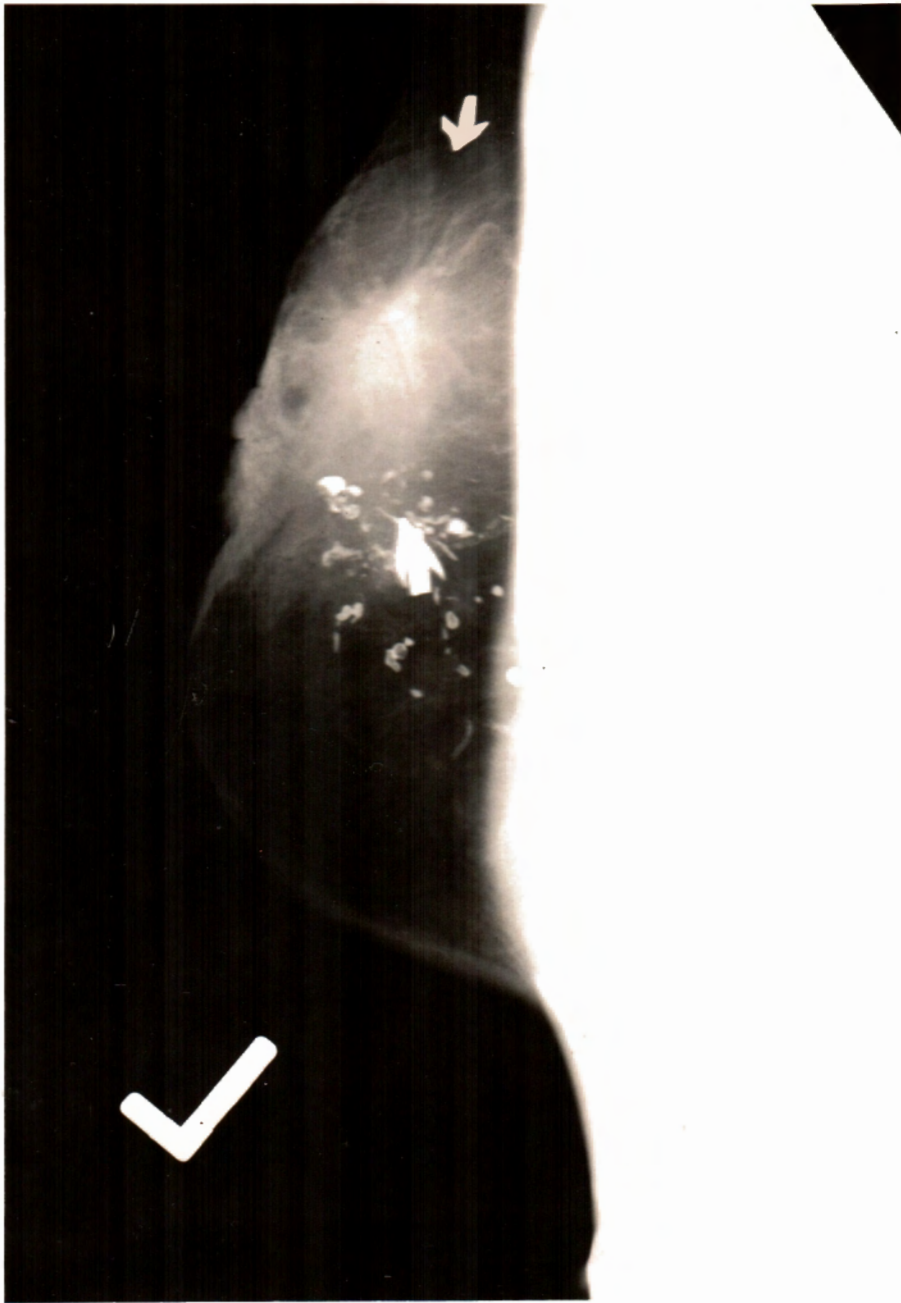


Fig. 3. Adenocarcinoma of the breast, female, age 76. (Lateral view) The carcinoma is demonstrated in the superior pole as an irregular area of increased density with spiculated margins associated with skin thickening and retraction of the nipple. The globular densities in the mid-portion of the breast represent benign ductal calcifications unassociated with the malignancy.

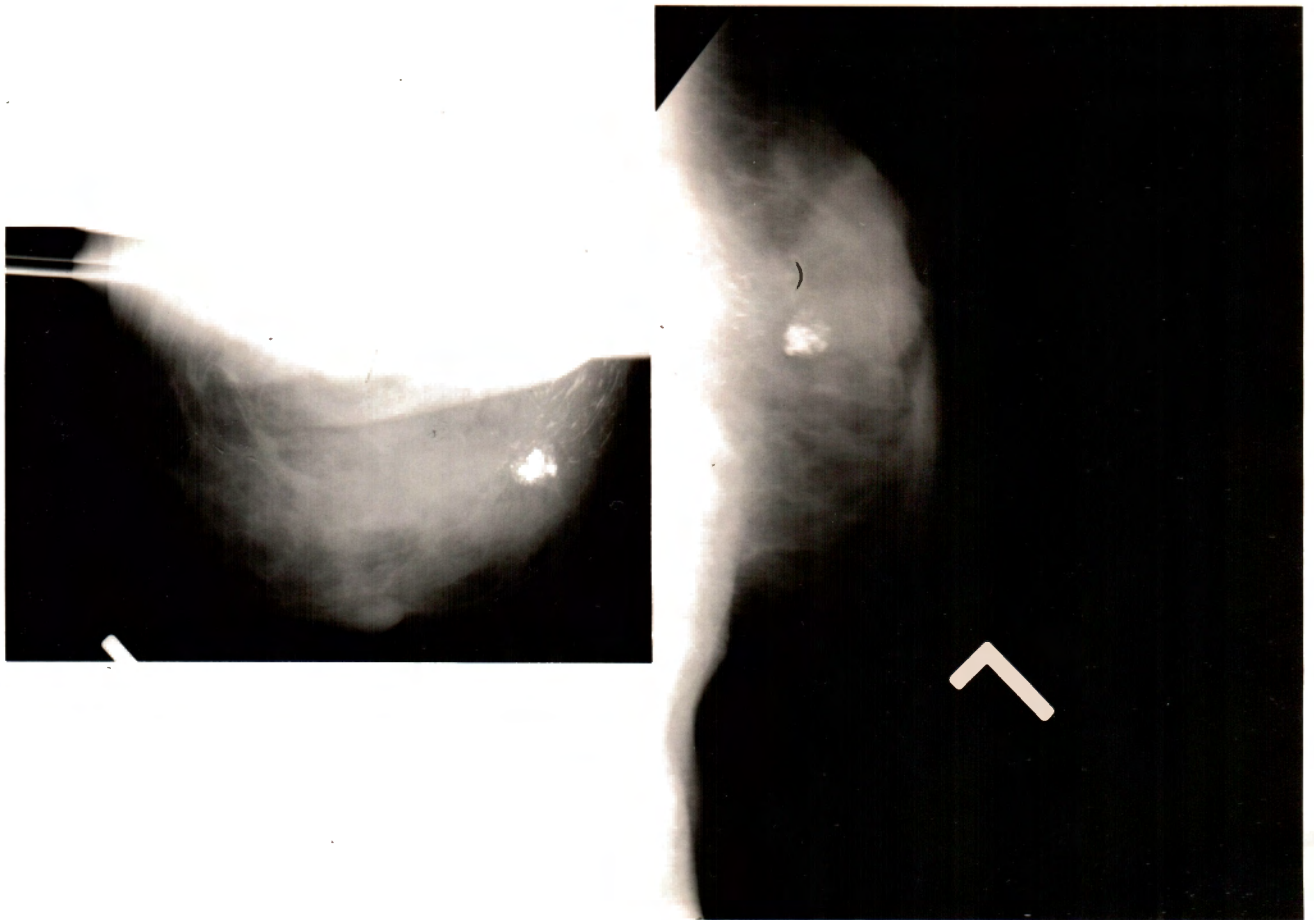


Fig. 4. Adenocarcinoma of the breast, female, age 52. (Cranio-caudal and lateral views) The carcinoma is demonstrated as a poorly defined area of increased density in the superior lateral aspect of the breast. Two types of calcification are demonstrated. The scattered punctiform calcifications deep in the breast are practically pathognomonic of carcinoma. The conglomerate calcific density is typical of fibrocystic disease.

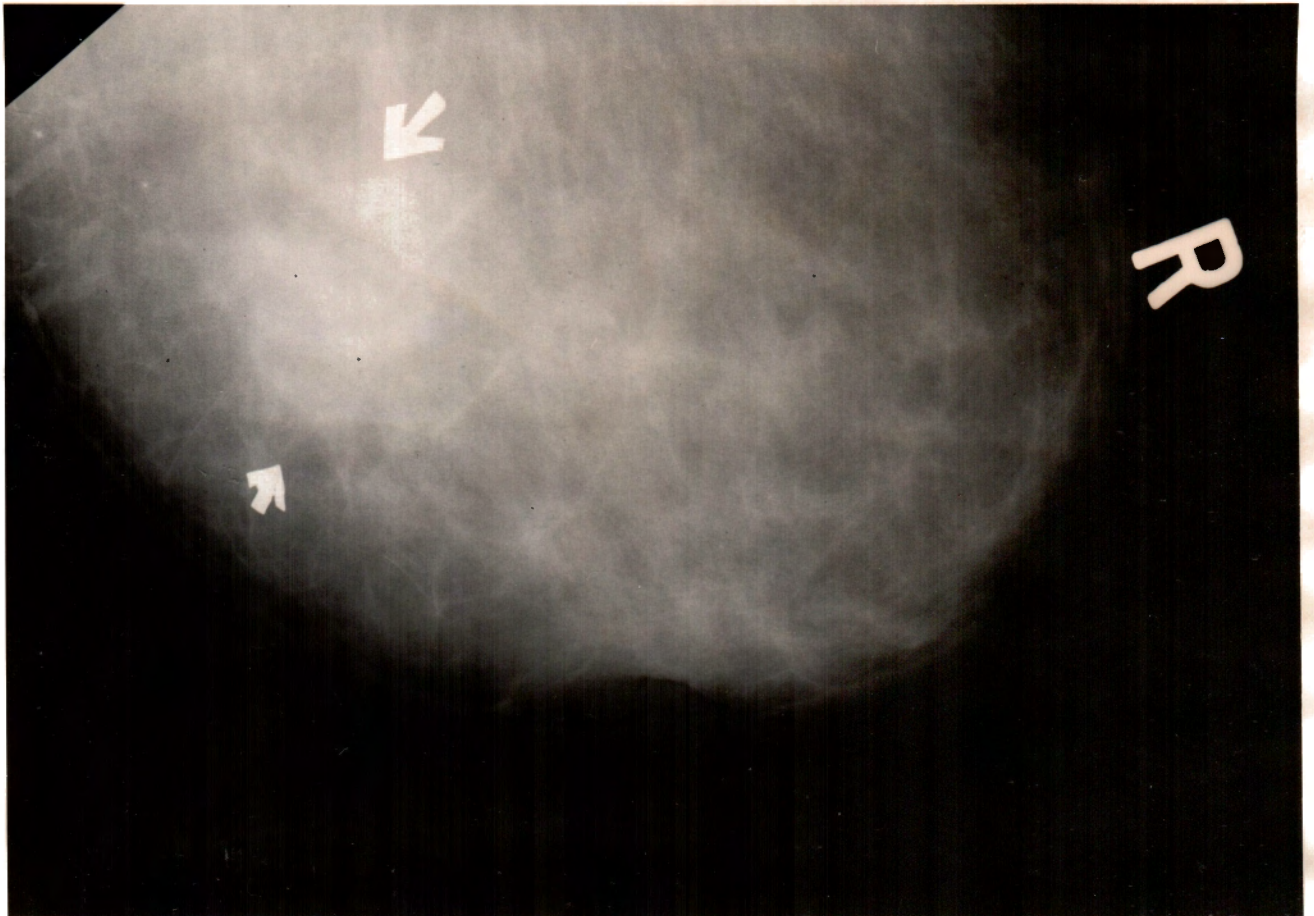


Fig. 5. Adenocarcinoma of the breast, female, age 70. (Cranio-caudal view) The carcinoma is visualized as a large poorly defined area of increased density in the lateral aspect of the breast. The skin thickening which was clearly demonstrated on the original x-ray films is not clearly demonstrated on the photograph.

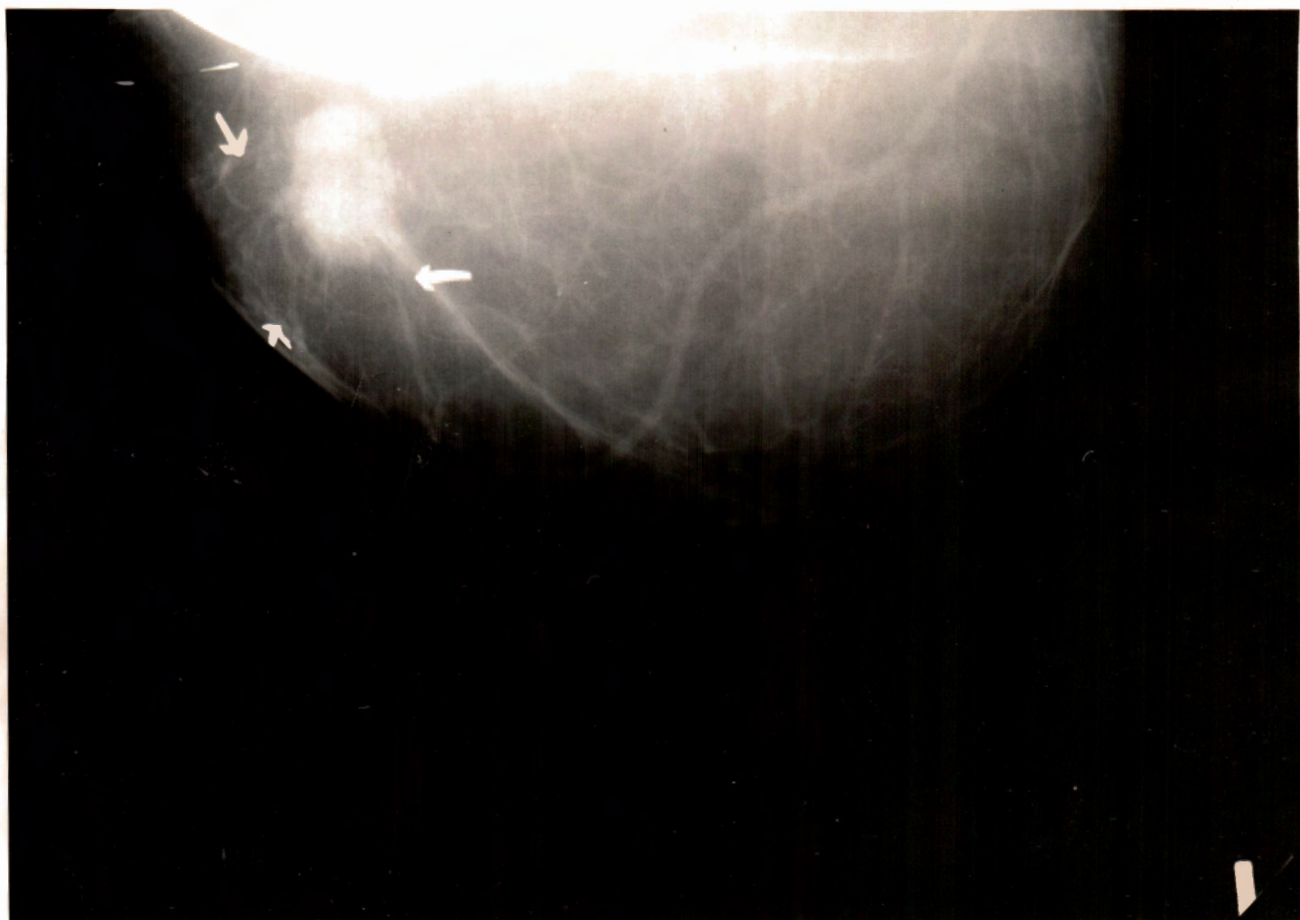


Fig. 6. Adenocarcinoma of the breast, female, age 56. (Cranio-caudal view) The carcinoma is demonstrated in the lateral aspect of the breast as an ovoid area of increased density with stellate ramifications and frond-like accentuations associated with a large vessel ramifying toward the lesion demonstrating hypervascularity.

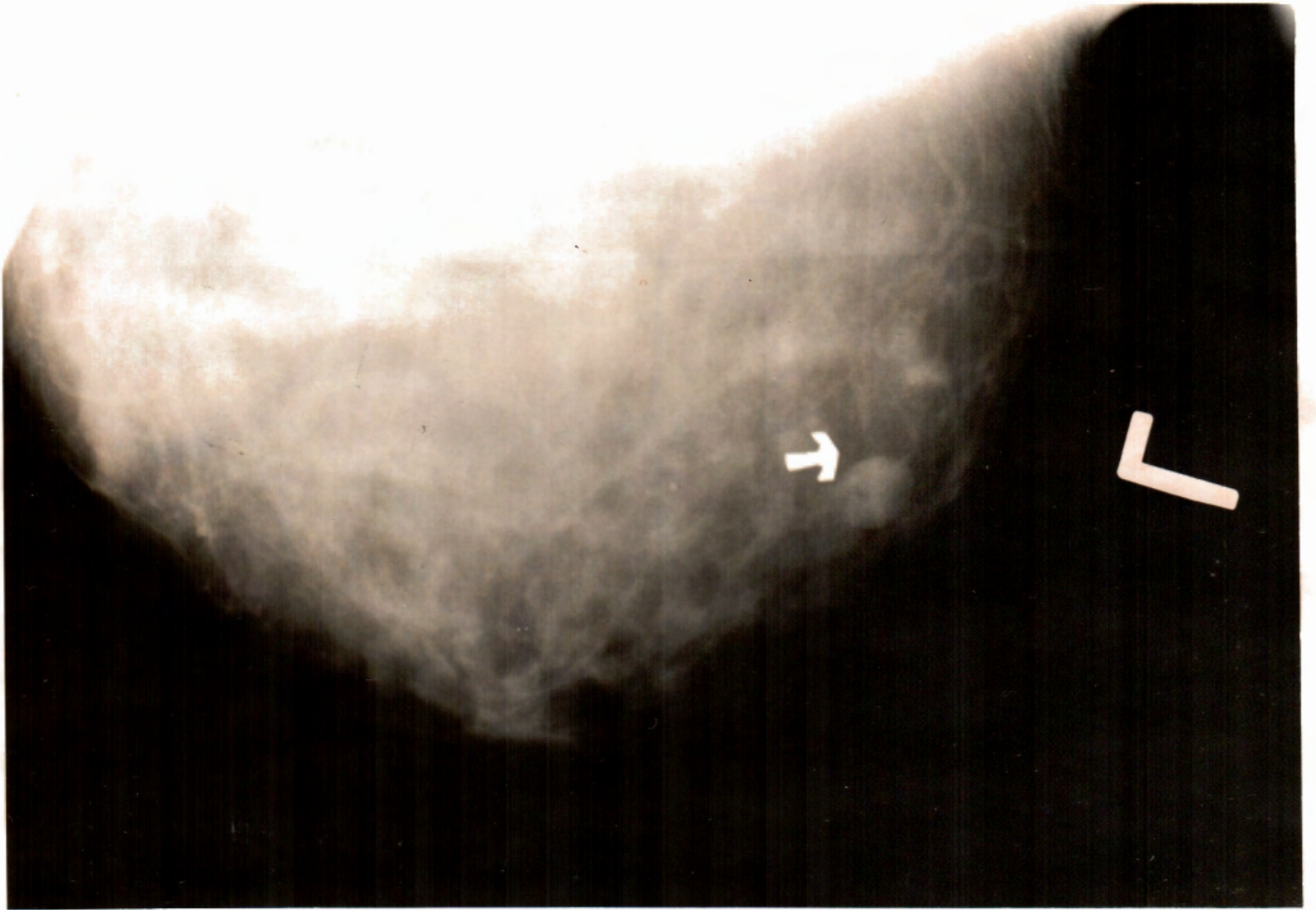


Fig. 7. Fibrocystic disease, female, age 49.. (Cranio-caudal view) There is a diffuse increase in the fibrotic component of the breast. The smooth circumscribed area of increased density represents a cyst.

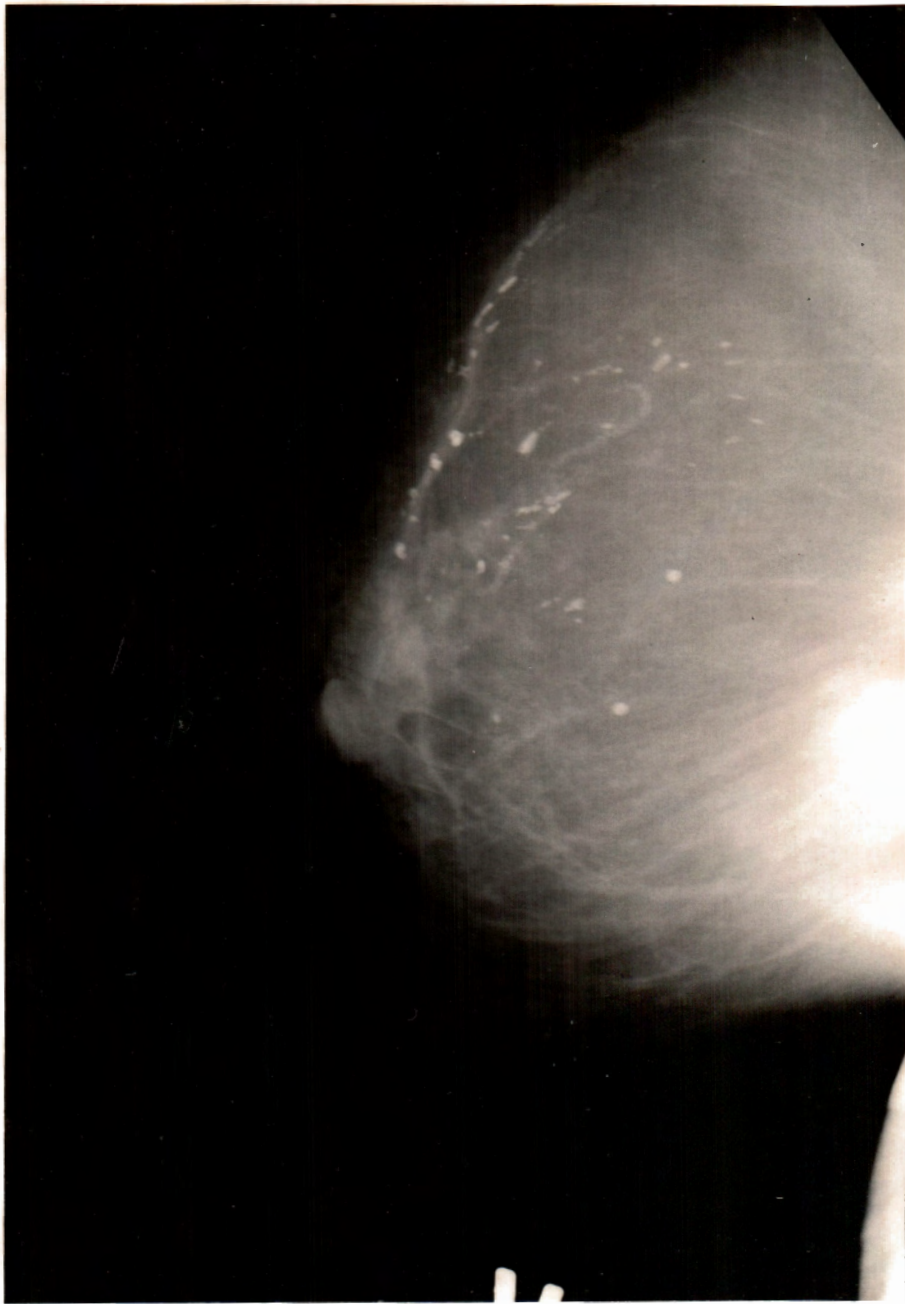


Fig. 8. Intraductal papillomatosis of breast, female, age 64. (Lateral view) The papillomae are demonstrated by the nodular densities beneath the nipple. Scattered globular ductal calcification is demonstrated. Early vascular calcification is demonstrated by the circumlinear granular calcification in the mid-superior area of the breast.



Fig. 9. Fibroadenoma of the breast, female, age 63. (Lateral view) The fibroadenoma is demonstrated beneath the nipple as a well-defined homogenous circular radiopacity with nodular calcifications. The adjacent dense globular calcification represents a benign ductal cyst.

BIBLIOGRAPHY

1. Salomon, A., Beiträge zur Pathologie und Klinik der Mammacarcinoma, Arch. f. klin. Chir. 102:573-668 1913.
2. Goyanes, J. and others, Radiography of Mammary Gland and Its Diagnostic Value, Arch. Espana. de Oncol. II:451-465 1931.
3. Klunschmidt, O., Brustdrüse. (In: Zweife, P. and others, Du Klinik der bösartigen Geschurflse, Leipzig, 1927, p. 5-90)
4. Finstubusch, R. and Gross, F., Kalkablagerungen in ein Melch-und Ausführungsgänger beider Brustdrüsen, Röntgenpraxis 6:172-174 1934.
5. Warren, S. L., Roentgenologic Study of Breast, Am. J. Roentgenol. and Rad. Therapy 24:113-124 1930.
6. Seabold, P. S., Roentgenographic Diagnosis of Breast Diseases by X-ray, Am. Surg. 94:443-444 1931.
7. _____, Roentgenographic Diagnosis of Diseases of Breast, Surg., Gynec. and Obst. 53:461-468 1931.
8. _____, Procedure in Roentgen Study of Breast, Am. J. Roentgenol. and Rad. Therapy 29:850-851 1933.
9. Reimann, S. P. and Seabold, P. S., Correlation of X-ray Picture with Histology in Certain Breast Lesions, Am. J. Cancer 17:34-41 1933.
10. Lockwood, I. H., Roentgen-ray Study of Mammary Gland, South. M. J. 25:903-907 1932.
11. _____, Roentgen-ray Evaluation of Breast Symptoms, Am. J. Roentgenol. and Rad. Therapy 29:145-155 1933.
12. Lockwood, I. H. and Stewart, W., Roentgen Study of Physiologic and Pathologic Changes in Mammary Gland, J. A. M. A. 99:1461-1466 1932.

13. Gershon-Cohen, J. and Strickler, Albert, Roentgenologic Examination of Normal Breast; Its Evaluation in Demonstrating Early Neoplastic Changes, Am. J. Roentgenol. and Rad. Therapy 40:189-210 1938.
14. Hunt, H. B. and Huken, A. F., Evaluation of Various Diagnostic Procedures Used in Study of Breasts, with Particular Reference to Roentgenographic Examination, Radiology 33:712-724 1939.
15. Leborgne, R. A., Diagnosis of Tumors of the Breast by Simple Roentgenography; Calcifications in Carcinomas, Am. J. Roentgenol. and Rad. Therapy 65:1-11 1951.
16. Lane, E. L. and Pendirgass, E. P., Addition to Technique of Simple Breast Roentgenography, Radiology 48:226-268 1957.
17. Egan, R. L., Experience with Mammography in a Tumor Institution; Evaluation of 1000 Studies, Radiology 75:894-900 1960.
18. Leborgne, R. A., The Breast in Roentgen Diagnosis, Impresora Uruguaya S. A. 1956.
19. Ingleby, Helen and others, Gestational Breast Changes; X-ray Studies of the Human Breast, J. of Obst. and Gynec. 10:149-157 1957.
20. Lockwood, I. H., The Value of Breast Radiography, Radiology 23:220-226 1934.
21. Gershon-Cohen, J. and Ingleby, Helen, Carcinoma of the Breast; Roentgen Technic and Diagnostic Criteria, Radiology 60:68-76 1953.
22. Gershon-Cohen, J. and others, Detection of Breast Cancer by Periodic X-ray Examination; A Five Year Survey, J. A. M. A. 170:114-116 1961.
23. Jensen, C. and others, Evaluation of Annual Examination in the Detection of Cancer; Special Reference to Cancer of Gastrointestinal Tract, Prostate, Breast and Female Generative Tract, J. A. M. A. 174:1783-1788 1960.

24. Holleb, A. I. and others, Breast Cancer Detected by Routine Physical Examination; Three Year Survey of Strong Cancer Prevention Clinic, New York J. Med. 60:823-877 1960.
25. Egan, R. E., Personal communication.