

X-RAY ANALYSIS OF THE NARBONNE HOUSE

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The Narbonne House is located in Salem, Massachusetts, which is about 15 miles north of Boston. The house stands on its original site, fronting on Essex Street, and is approximately 200 yards from the Salem Harbor waterfront. The house and grounds back up to the National Park Service's Salem Custom House property, and thus is part of their Salem Maritime National Historic Site.

The house was probably erected in the 1670's and most likely had addition to the south at an early date. The shed additions to the east probably were made in the mid 1700's. The Narbonne House is an excellent example of a tradesman's home, and has survived down through the years in a relatively undamaged state. Therefore, it serves as a valuable interpretive structure, both for public viewing and serious study. [Ed. Note: The purchase of the house was authorized by the U. S. Congress in 1963 to "preserve one of the few substantially unaltered half houses of 17 C. Massachusetts." See 88-199,88 Congress. H.R. 976 dtd, Dec. 12, '63, 77 Stat. 359, Passed House July 8, 1963, Passed Senate Nov. 7, 1963].

Recently, the Society for the Preservation of New England Antiquities was engaged by the National Park Service to carry out a study and report which will be part of the process to determine the house's future treatment in the historic site complex. The study involved research, field structural examination and archeological examination.

In addition, an X-ray analysis was carried out to determine certain structural conditions hidden from view. Specifically, the examination was made in hopes of finding evidence in three areas. First, the existence and configuration of exterior wall bracing; second, the possibility of finding original window framing; third, the possibility of evidence between the two house frames that would indicate whether the south frame once had an exterior wall. The equipment used was Picker Corporation's Portashot System, which is a portable X-ray generator and Polaroid film and processing unit for on-the-job analysis of results.

As seen by the casual observer, the Narbonne House appears as a non-descript gray house fronting on Essex Street. However, the steeply pitched roof and large chimney (which is currently covered by

Ed. Note: For an earlier article describing the author's "experimental efforts to develop the X-ray process as a means of exploring invisible conditions within historic structures," see "X-Ray Investigation of Buildings," APT Bulletin, Vol. V, No. 1, 1973, pp. 9-21.

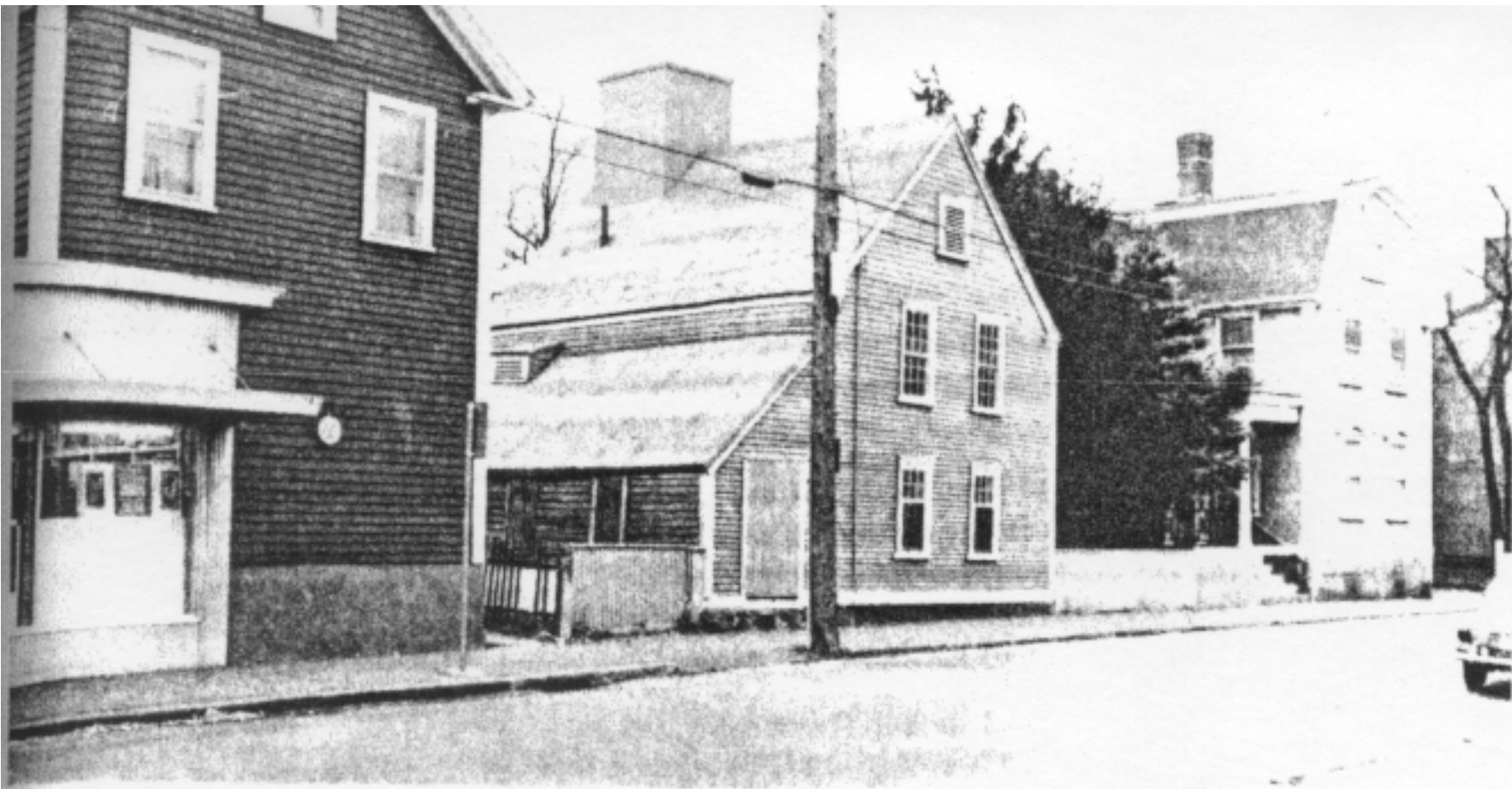
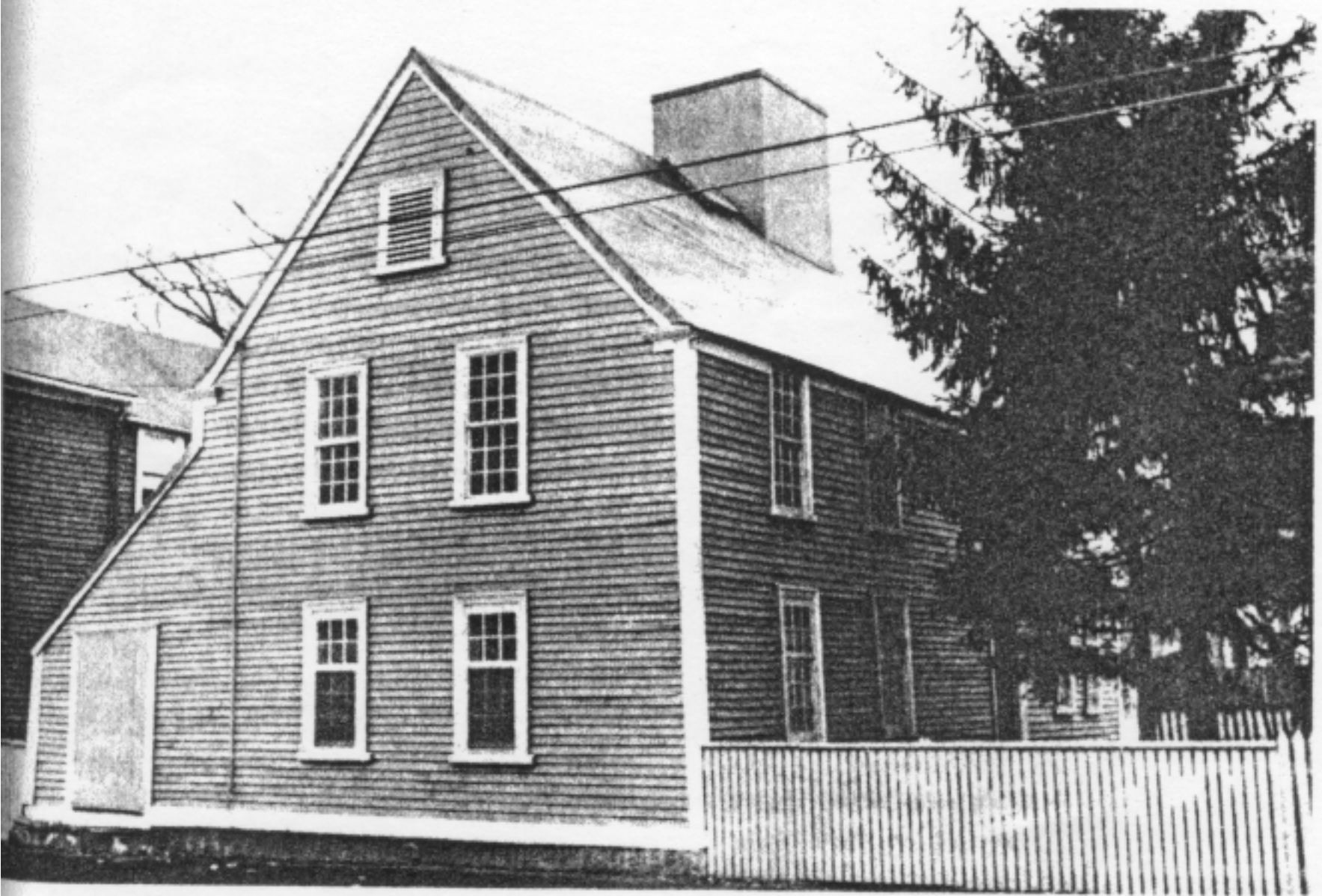


Fig. 1 and 2 Two views of Narbonne House from Essex Street, showing later shed addition to east.



plywood to protect the deteriorating chimney), are clues to its early origins. As we move around the house we can see two structures - the early to the north, the later gambrel addition to the south (see Fig. 1-3).

The first part of the investigation was the determination of the wall bracing and its configuration. For historical purposes, it was desired to know if the corner braces "rose" or "fell" inside the walls, at both the first and second floor levels. By visual analysis one could not determine the bracing. Furthermore, by tapping the walls and examining the ridges in the plaster, one would be led to believe that the braces rose. Interestingly enough, the X-rays revealed just the opposite case: the braces fell in all instances (see Fig. 6 and 7).

From this information, we can put together a composite picture of the framing (Fig. 8-10) and illustrate how the structure looks. Each X-ray is indicated by a small rectangle, and the cross-hatched areas are X-ray evidence of the brace within the wall.

In addition, the examination gave us a good bit of additional information in other sectors:

- 1) Braces showed no sign of structural failure, rot or decay;
- 2) Even though nogging was visually present in the east wall at the second floor level, it was not apparent in the west, north or first floor east walls;
- 3) Cut nails used to attach the clapboards to the studs are clearly seen;
- 4) Irregularly-shaped split lath is seen, as well as the hand-wrought nails used to attach the lath to the studs.

As a matter of interest, the X-rays were made during some very cold days in December, and the house was unheated. It was necessary to keep the film, processor and holder warm by means of heat lamps; otherwise, the Polaroid process was slowed down considerably, and also made for inferior results.

The second phase of the investigation was to determine the possibility of original window frames in the exterior walls. It was hoped that some evidence in the form of window frame fragments might be found. In addition, perhaps notches would be found in the studs or posts that would indicate the position of a window frame since removed. The results are shown in Fig. 11 and 12. The studs and posts, plus the wall, were searched for this type of evidence.

The lack of any evidence suggests three alternate explanations:

- 1) There were never any early windows in the wall;
- 2) The window frames were let into the sheathing, and this has been removed;
- 3) The studs have been replaced, taking any evidence with them.

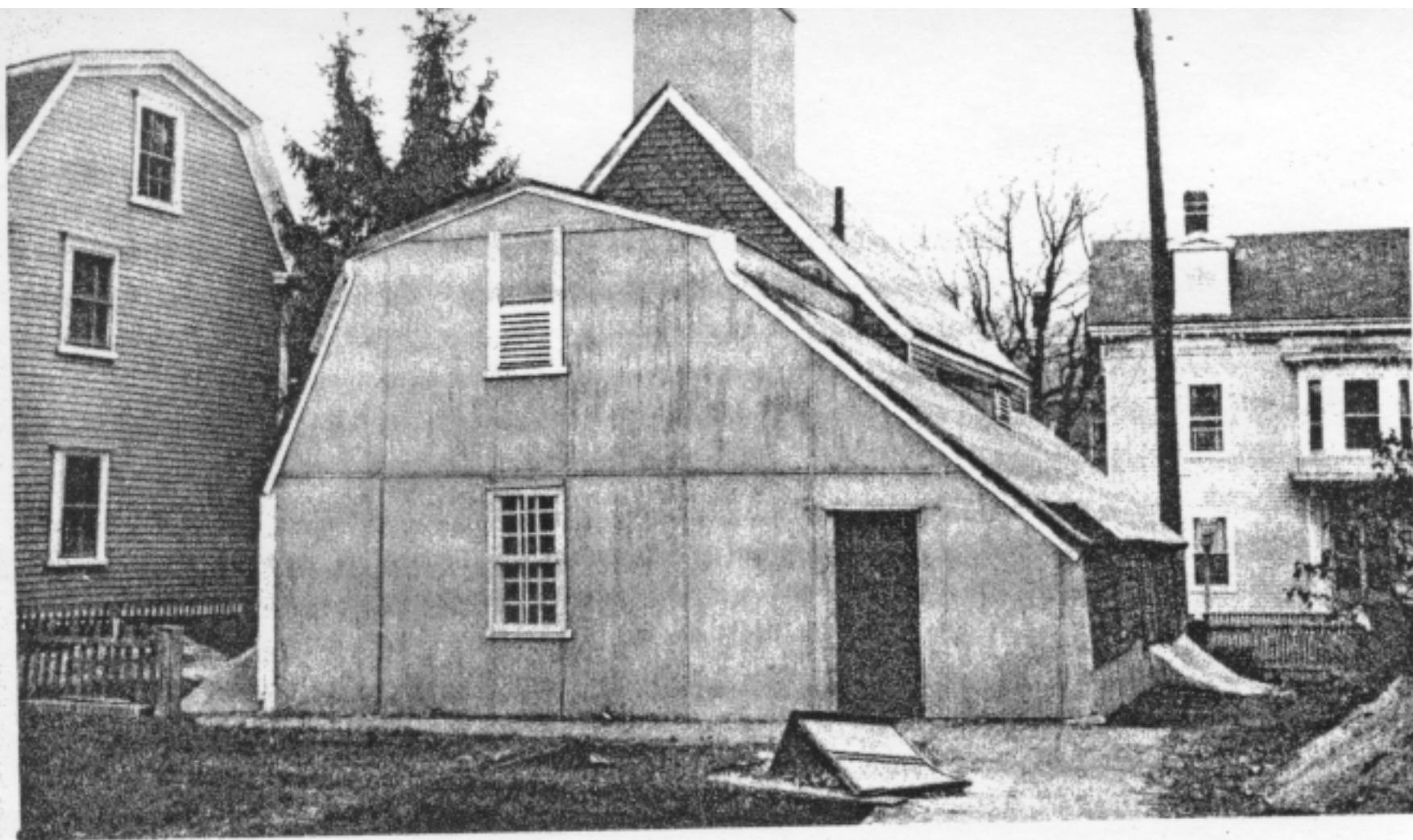
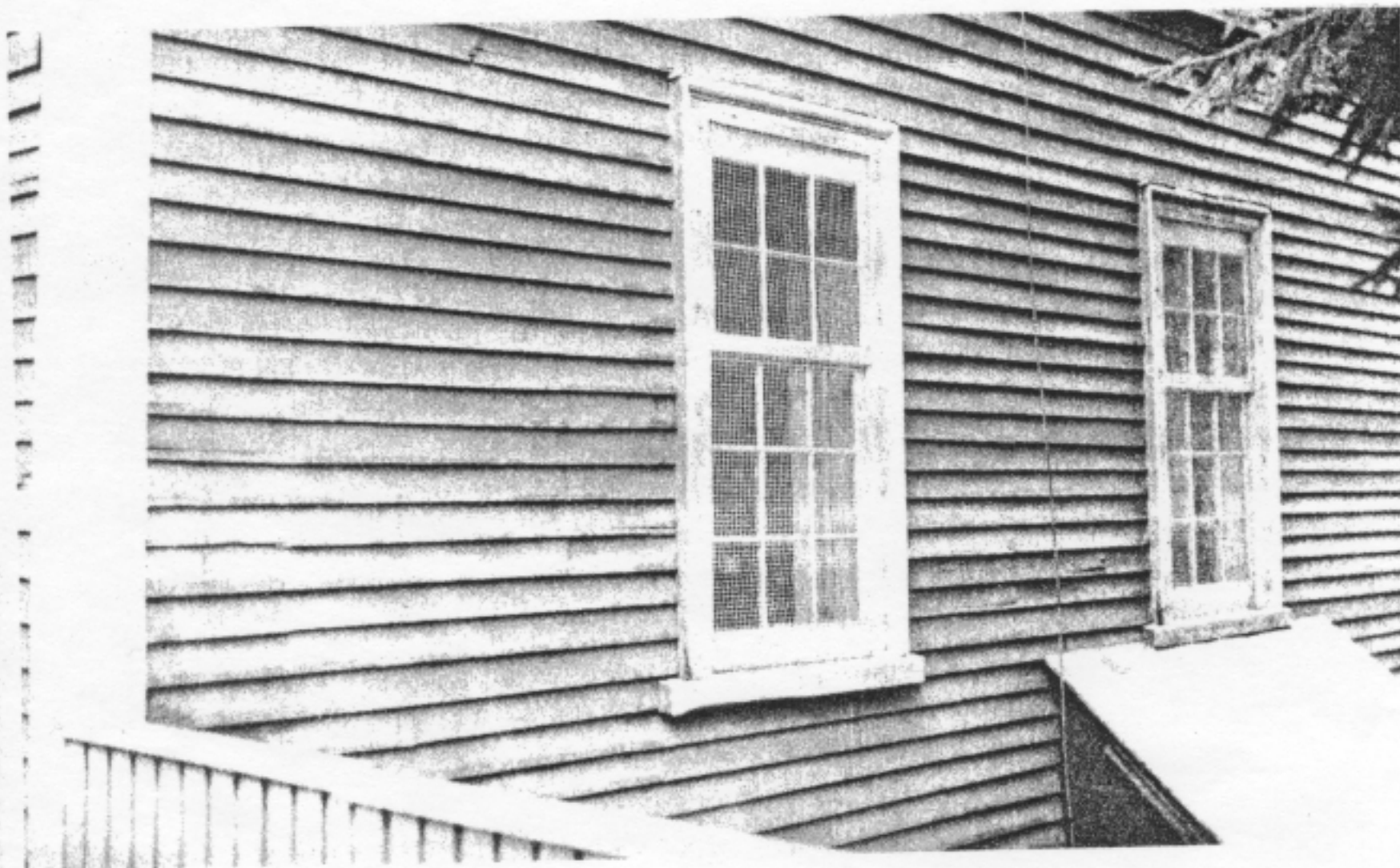


Fig. 3 Narbonne House from rear yard. Chimney and gambrel - shed gable end are temporarily covered with plywood to prevent further deterioration of materials.

Fig. 4 Exterior view of north-west corner. X-ray examination for brace and original window frame started in this area.



Next, the window itself was examined by X-ray, particularly around the lower corner of each side (see Fig. 13-17). Here again, there was no evidence of either a window frame that could date to the original, or any evidence of notches in the surrounding sheathing that would indicate an earlier frame. The possibility of the early frame being used as a base for the present frame is not entirely discounted, however, as there could be additional evidence that is obstructed, or not clear to us at this time.

From this phase we have determined the present window frame condition and configuration. Also, we have examined the posts and studs in the area, and have seen that they are in good shape. As in the search for the braces, there is no evidence of noggings in the west wall.

The last phase of investigation was that area between the two house "halves." The north portion is known to have been built about 1675. Figure 18 shows that north portion and the later gambrel addition. Through structural research, it has been determined that there was an earlier addition to the south, but it undoubtedly has been removed. On the basis of style alone, the present gambrel addition would seem to date from the 1720's at the earliest. At the present time, there is unfortunately no documentary evidence to indicate just when this addition was made.

Evidence does exist that indicates that the present addition was once a separate structure, and was butted up against the north portion. One way to gather evidence of this was to examine the area between the frames, particularly the girts (see Fig. 19). If there was once an exterior wall, then stud mortices would probably be found. Actually, stud mortices were found in the north portion's frame by visual means, so examination by X-ray was limited to the south portion's girt. Fortunately for us, the girt in the south portion extended into the room below, thereby giving us a clear shot through the member. The unfortunate part is graphically shown in Fig. 22, which shows that the area we are most interested in has probably been previously removed by persons unknown. We are therefore frustrated in our attempts to obtain evidence that this was once an exterior wall. However, there are quite a few other interesting factors that came to light in this part of the investigation, and they are worthy of comment:

- 1) The joist and mortice shape, and configuration can be clearly seen. Their condition seems to be excellent;
- 2) It can be seen that there are a few large cut nails in the cut-away portion of the girt. As these probably do not date earlier than 1790, it is interesting to speculate if these are part of the work that joined the two frames together;
- 3) The lath in the ceiling is intriguing, as first of all, from its regular shape, it would appear to be sawn along both surfaces. Therefore it would date probably no earlier than 1820. The nails used to hold the lath to a furring

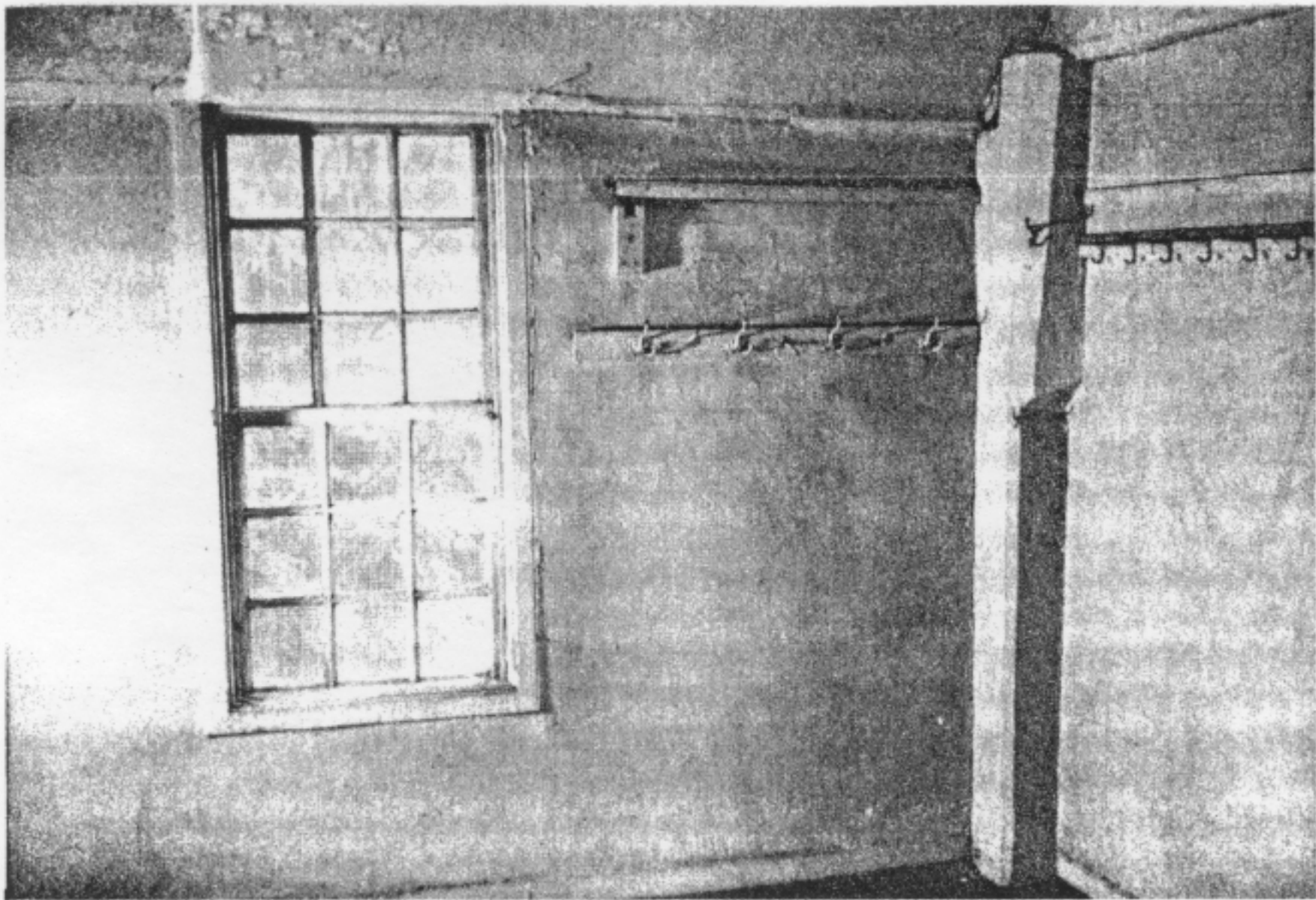


Fig. 5 Narbonne House, Interior view of north-west corner, second floor.

strip are cut, and this would be consistent with the sawn lath dating information. Secondly, the lath are evidently held to the ceiling by a furring strip, which uses cut nails for this purpose. So it seems that we have some fairly consistent information for use in dating the ceiling's earliest installation.

Of course now that we have analyzed these X-rays, we can only be anxious to make further examinations to perhaps probe into the house's background more thoroughly, and perhaps understand its origin and construction better.

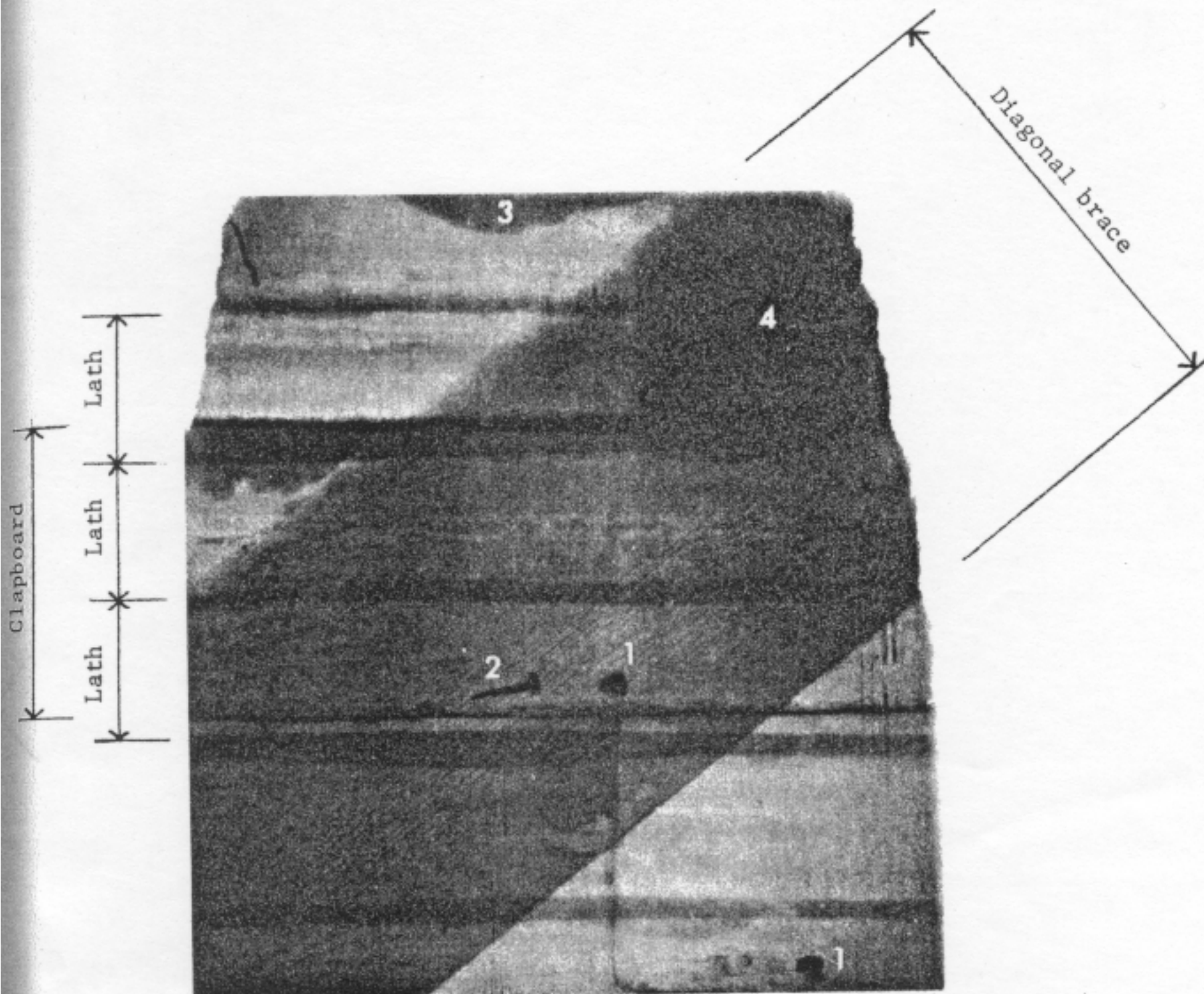


Fig. 6 Narbonne House, Salem, Mass.
 X-ray of brace located in area of Fig. 5.

- Key to X-ray:
1. Clapboard nails
 2. Wrought nail
 3. Plaster "key"
 4. Dark area, probably a mortise filled with debris, "unidentified."

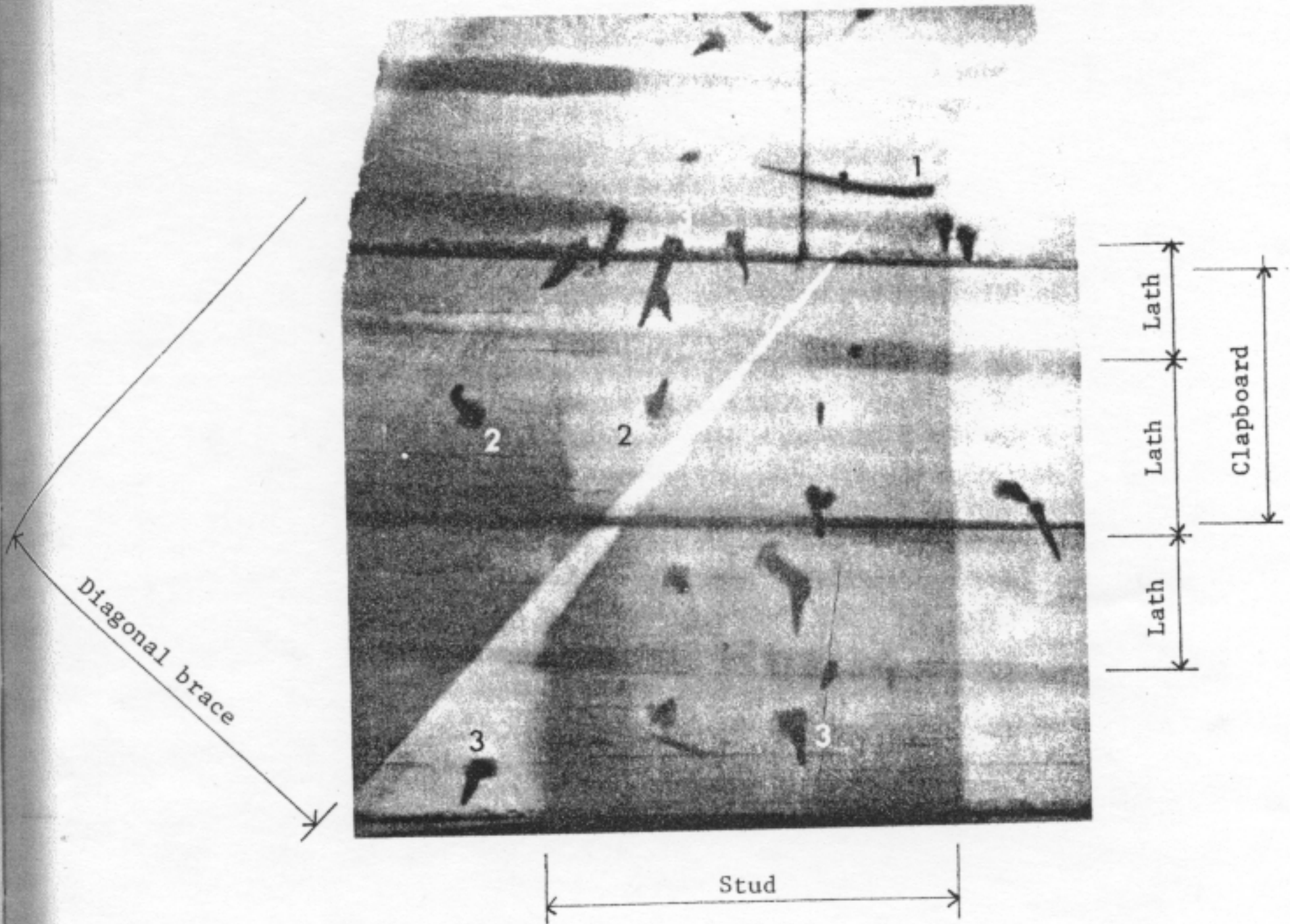
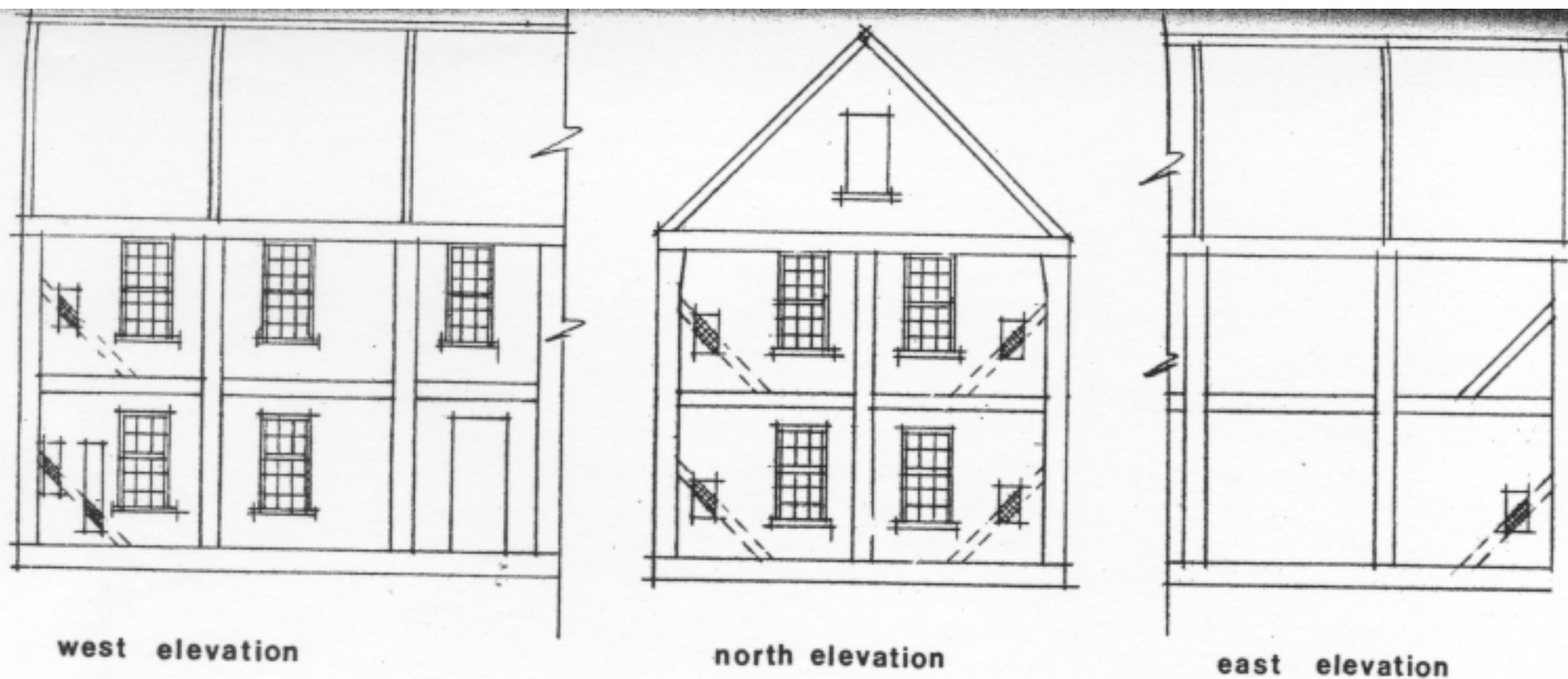


Fig. 7 Narbonne House, Salem, Mass.
 X-ray of brace (with stud portion at bottom), located in
 West wall, first floor.

- Key to X-ray:
1. Nail used to attach stud to diagonal brace
 2. Lath nails, wrought
 3. Clapboard nails, cut
 4. Butt-end of modern clapboard



west elevation

north elevation

east elevation

Fig. 8 (Left) Composite drawing; cross-hatched areas are those in which brace evidence was obtained by X-ray.

Fig. 9 (Center) Composite drawing, showing brace evidence in North wall.

Fig. 10 (Right) Composite drawing, showing brace evidence in East wall, second floor brace was determined visually.

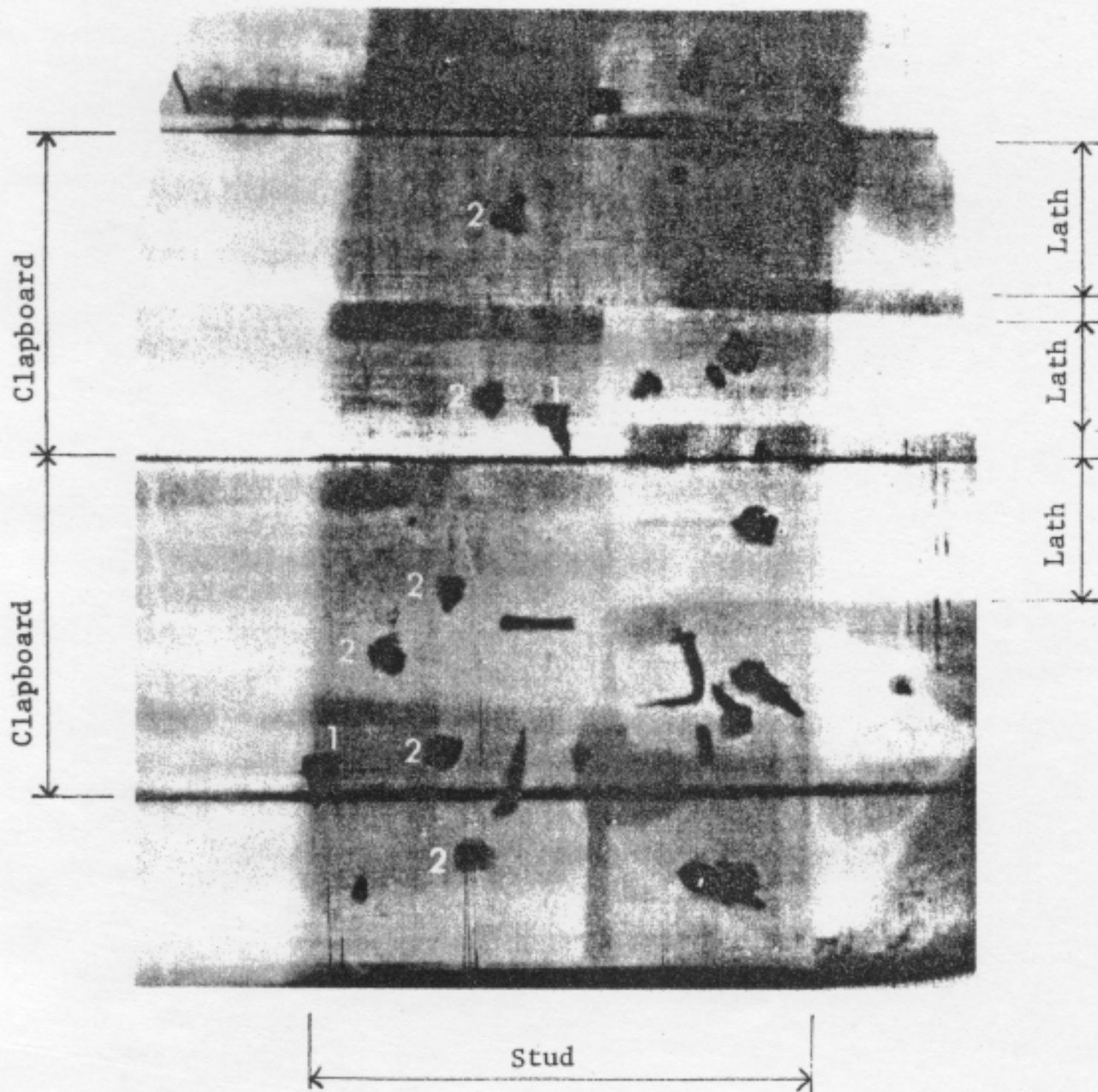
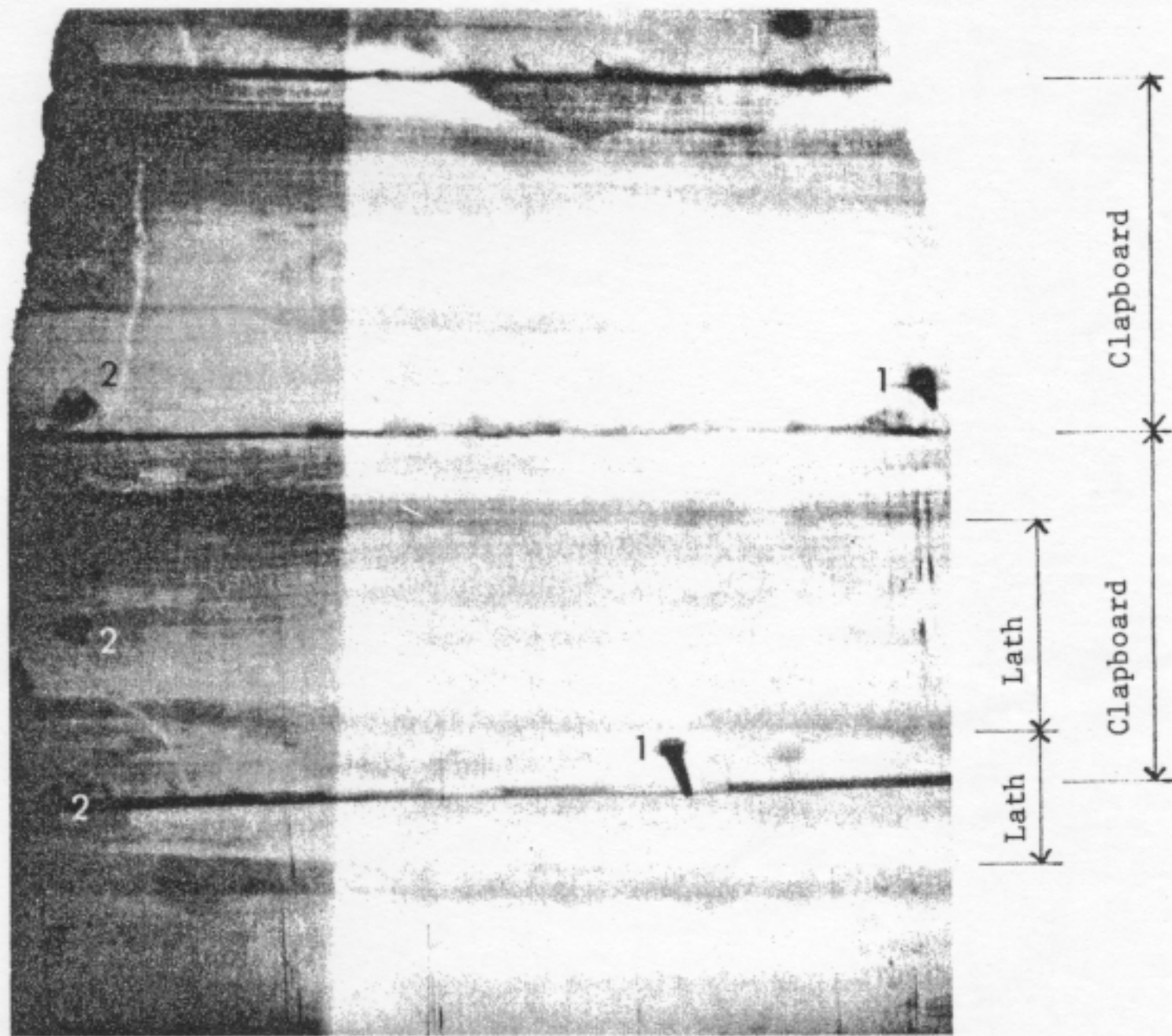


Fig. 11 Narbonne House, Salem, Mass.
 X-ray of stud, examined for possible notch used for original window frame. Lath configuration and wrought nails used for attachment are clearly seen. Cut nails can be seen, which attach clapboards.
 Key to X-ray: 1. Clapboard nails, cut
 2. Lath nails, wrought
 There are a few stray nails and broken nails in the stud.



Post →

Fig. 12 Narbonne House, Salem, Mass.
 X-ray of post, examined for possible notch used for original window frame. Cut nail used to attach clapboard to sheathing can be seen in lower right-hand corner.

Key to X-ray: 1. Clapboard nails, cut
 2. Lath nails, wrought

There are a few stray nails and broken nails in post.

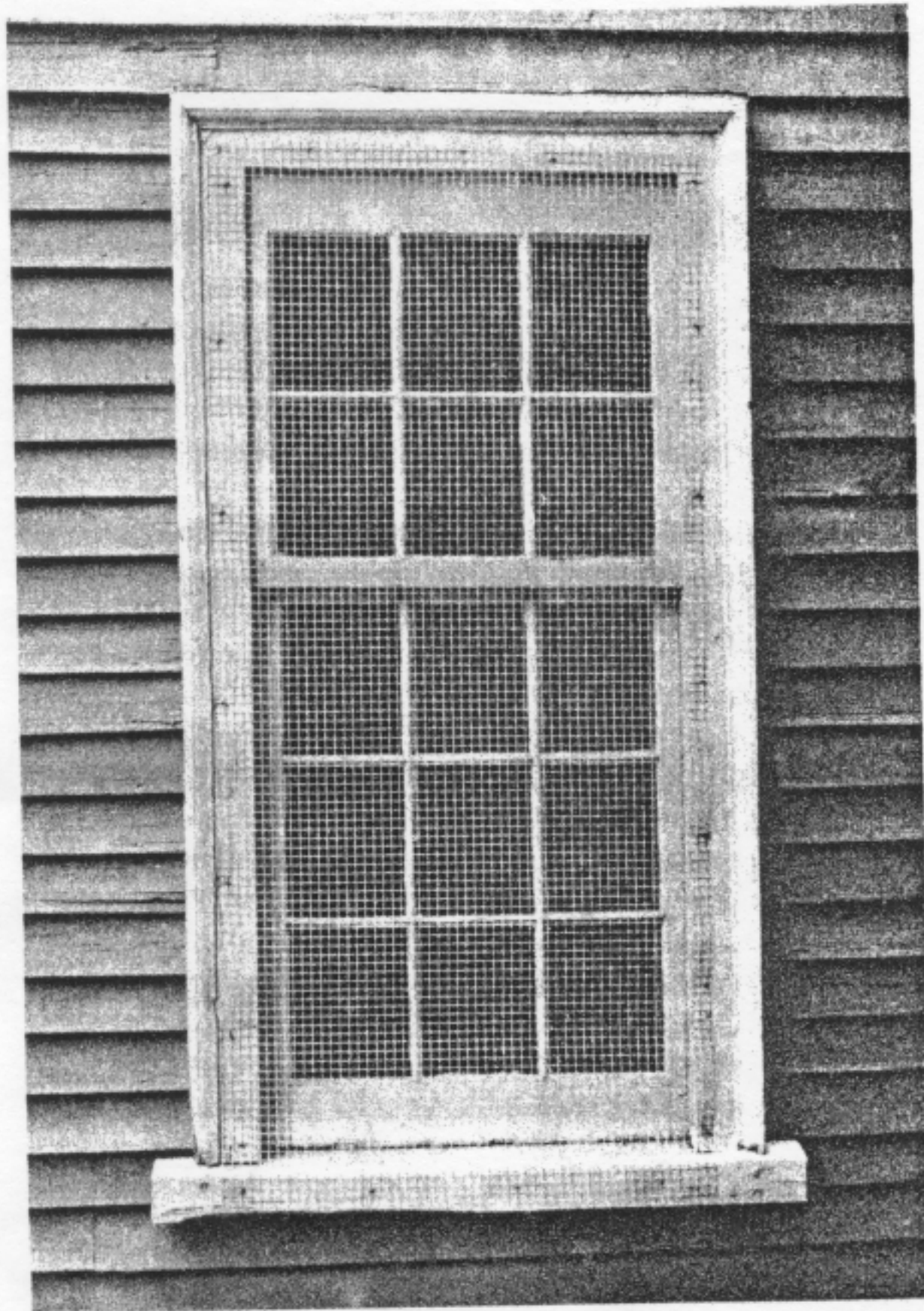


Fig. 13 Exterior of window located in wall that was examined for original window evidence.

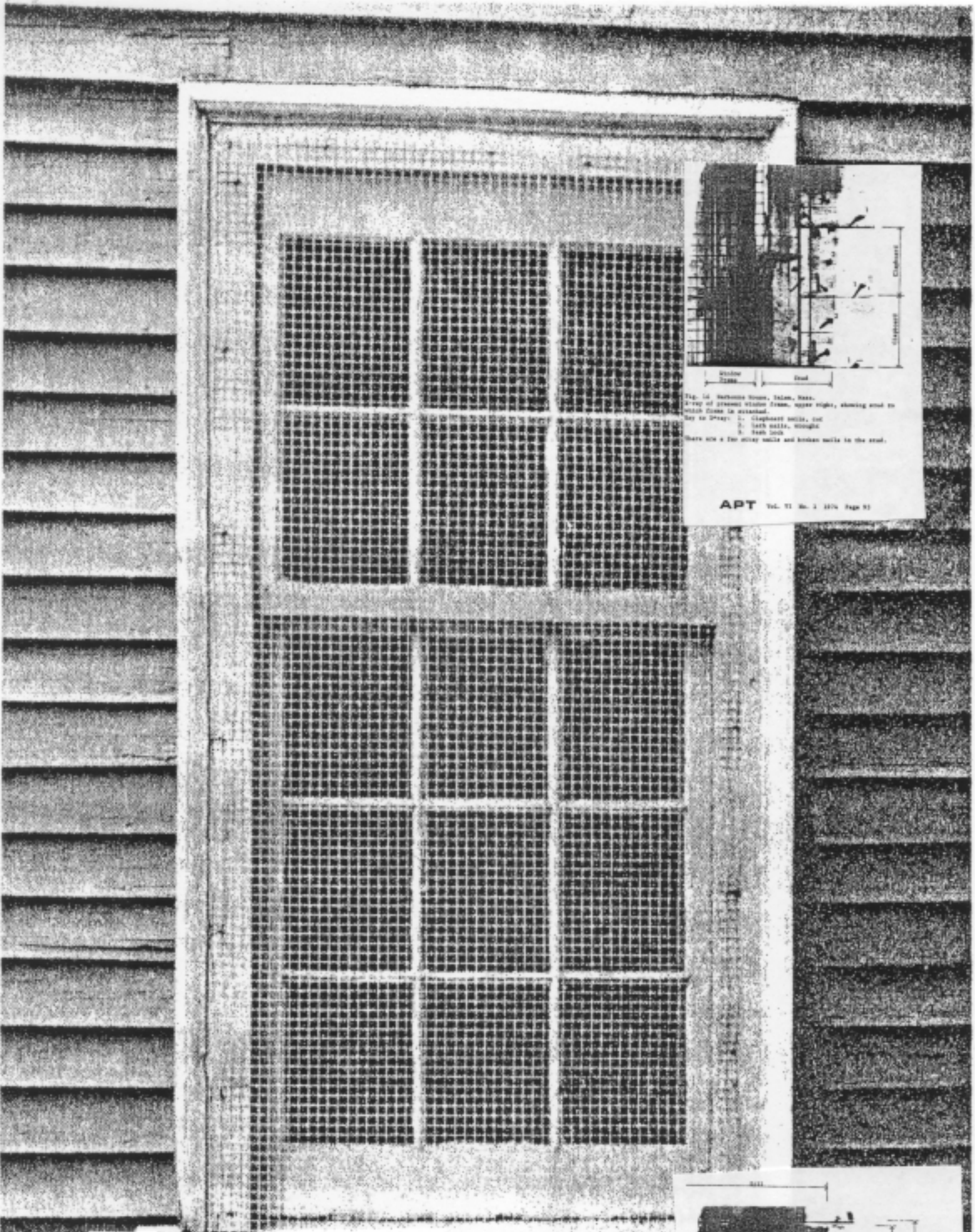


Fig. 14. Window frame, Salem, Mass.
 2-view of present window frame, upper right, showing steel to which frame is attached.
 Key to 2-view: 1. Clapboard siding, cut
 2. Mesh nails, wrought
 3. Mesh lock
 There are 4 for every mesh and broken nails to the steel.

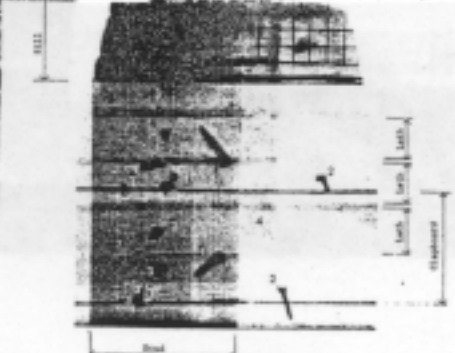


Fig. 11. Window frame, Salem, Mass.
 2-view of present window frame, lower left side.
 Key to 2-view: 1. Sheathing nails
 2. Clapboard siding
 3. Mesh nails, wrought
 4. Mesh lock bolted to steel
 5. Precast concrete mesh over window

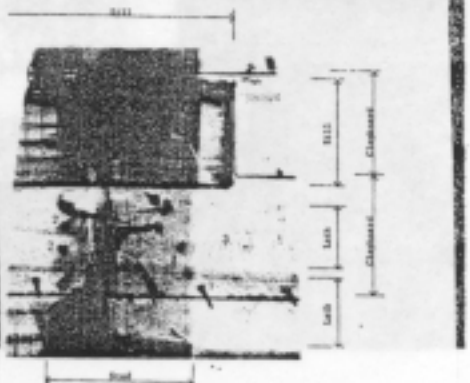


Fig. 13. Window frame, Salem, Mass.
 2-view of present window frame, lower right side.
 Key to 2-view: 1. Clapboard siding, cut
 2. Mesh nails, wrought
 3. Precast concrete
 There are 4 for every mesh and several nails to the steel, setting in the concrete.

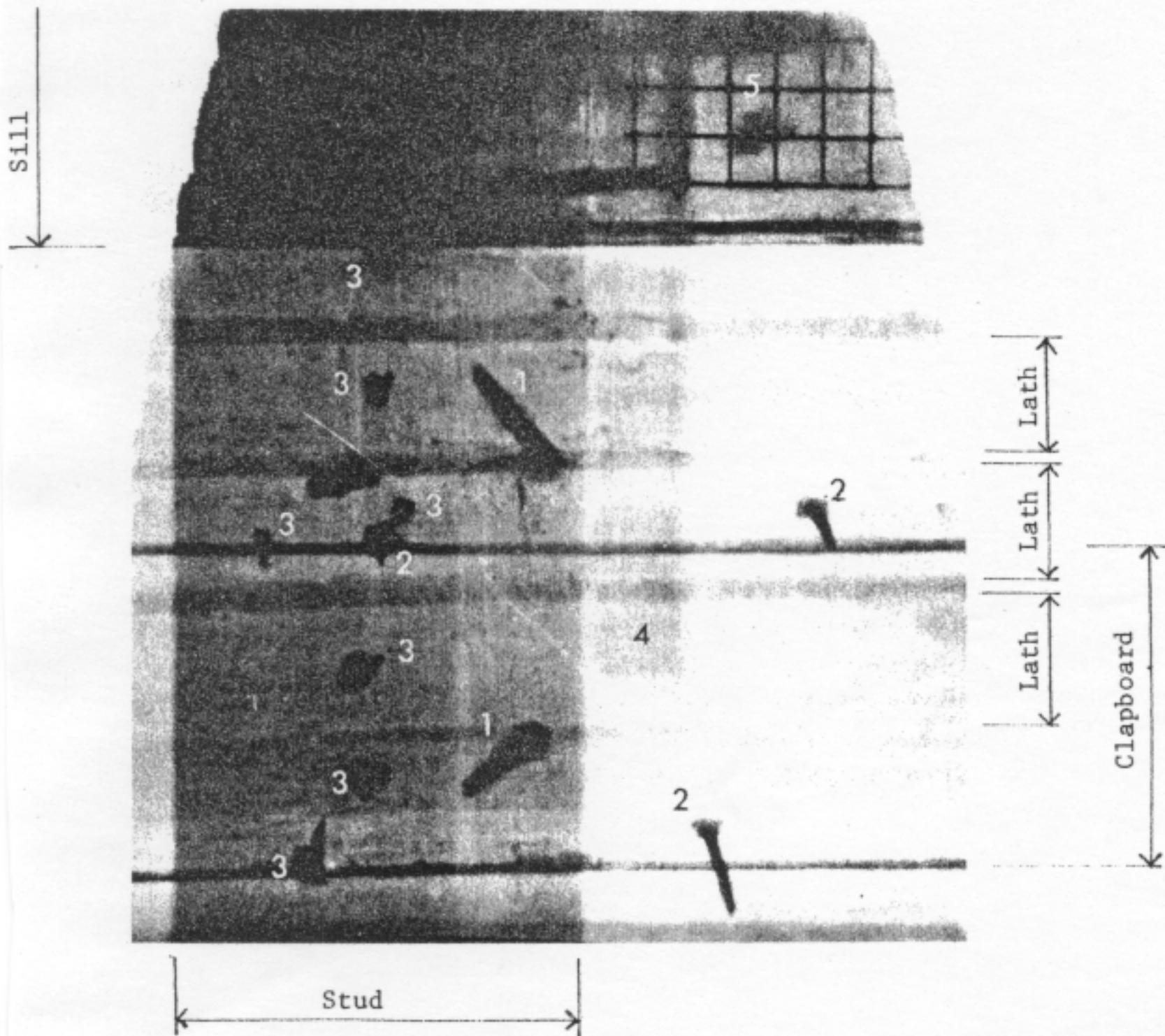


Fig. 14 Narbonne House, Salem, Mass.
 X-ray of present window frame, lower left sill.
 Key to X-ray: 1. Sheathing nails
 2. Clapboard nails
 3. Lath nails, wrought
 4. Wood block nailed to stud
 5. Protective wire cloth over window

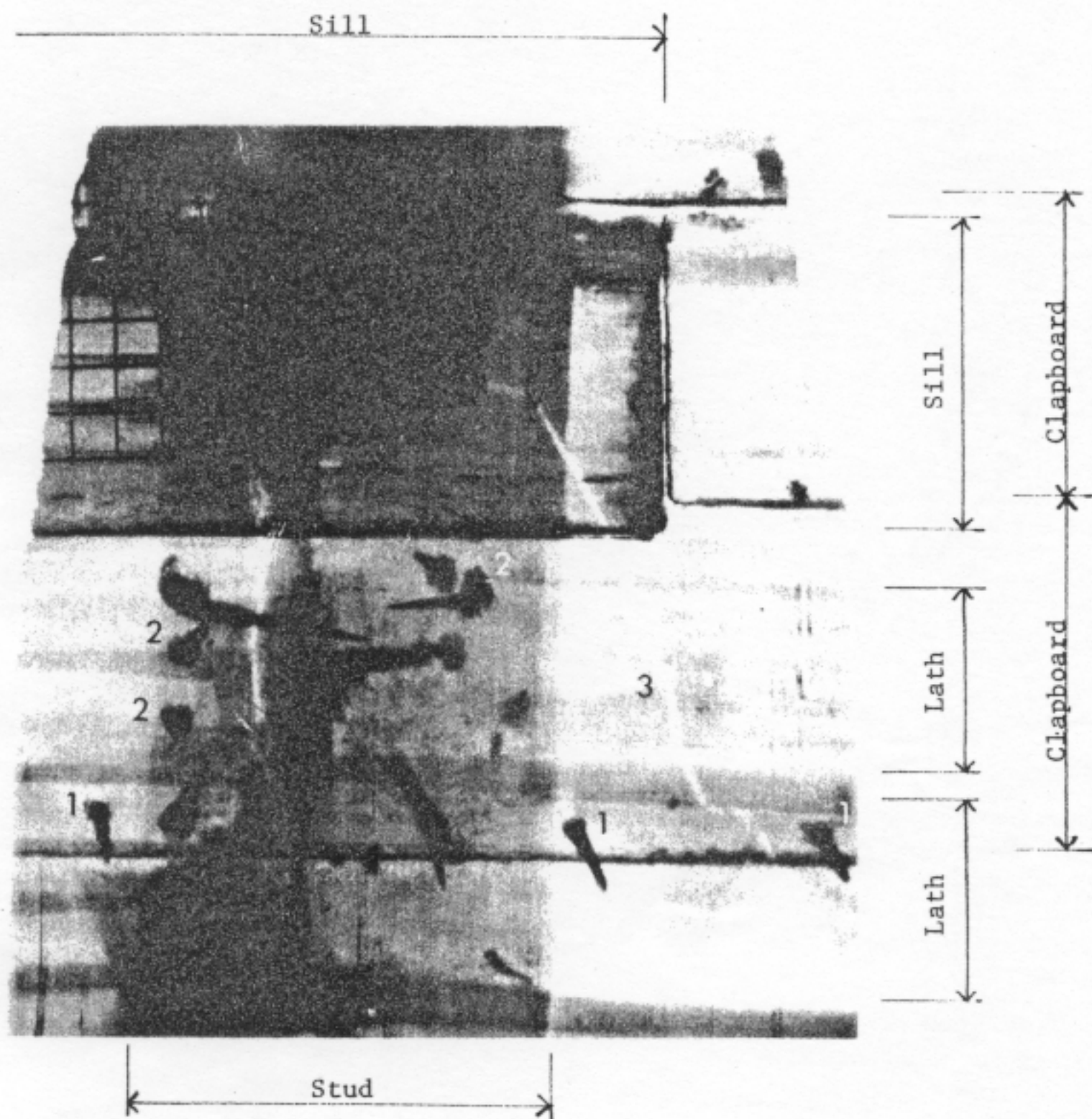


Fig. 15 Narbonne House, Salem, Mass.
 X-ray of present window frame, lower right sill.
 Key to X-ray: 1. Clapboard nail, cut
 2. Lath nails, wrought
 3. Plaster crack

There are quite a few broken nails and unused nails in the stud, adding to the confusion.

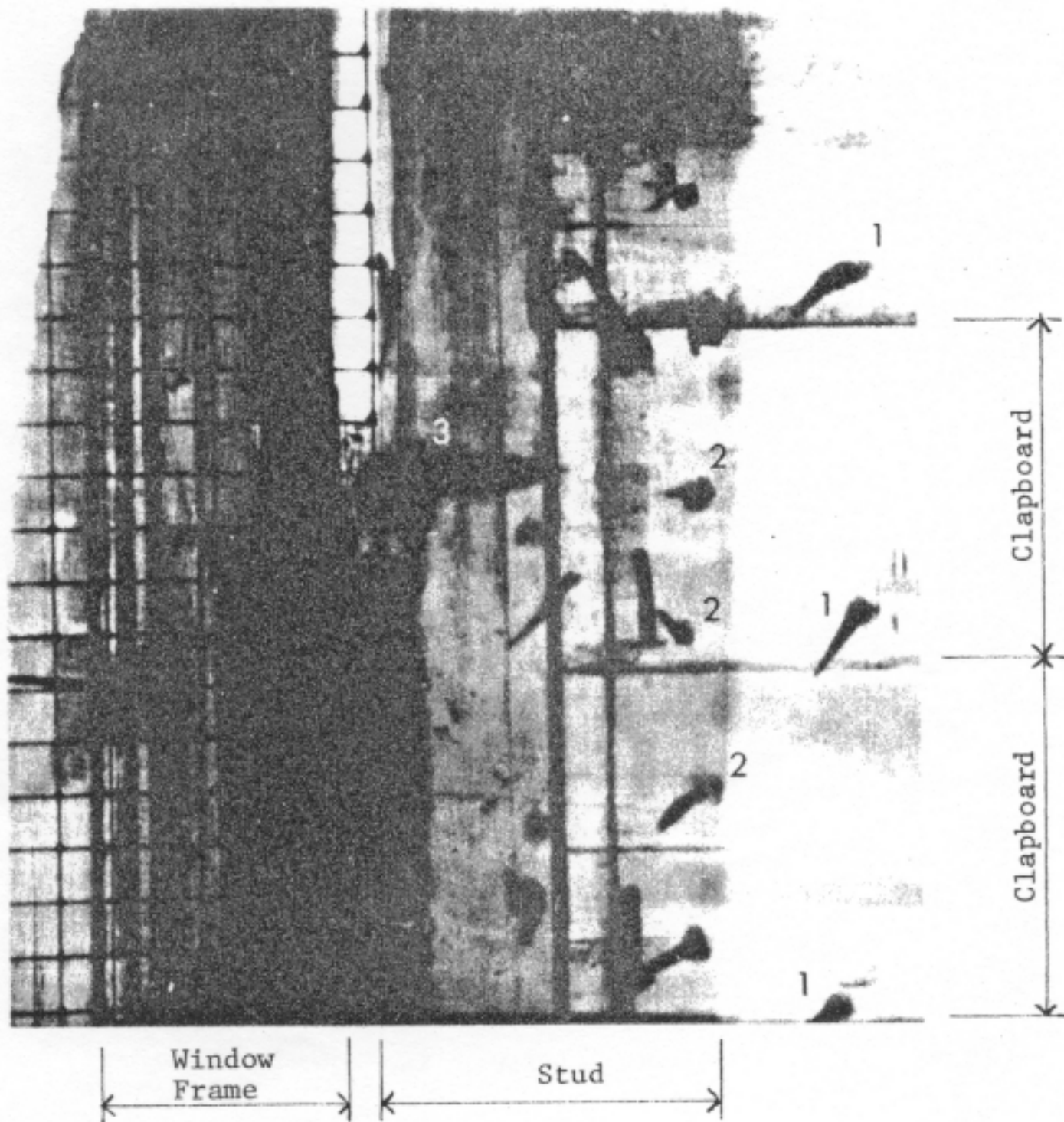
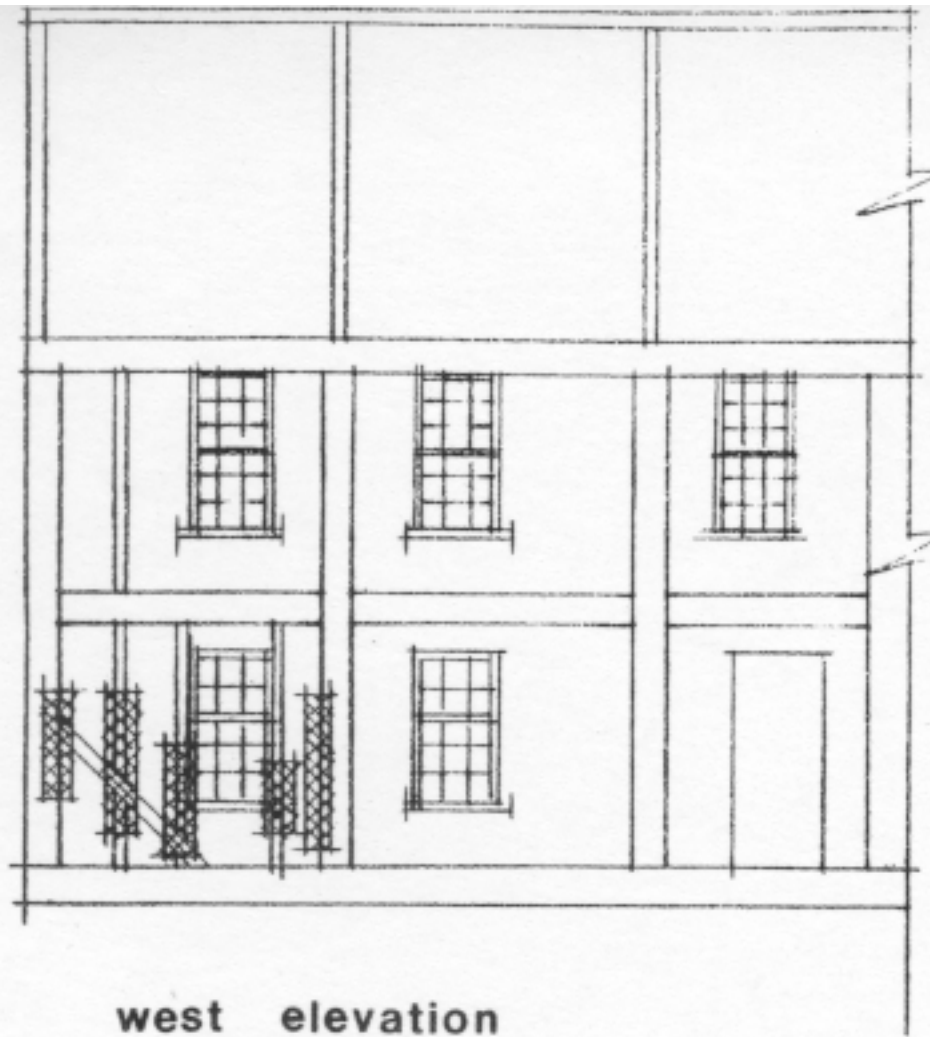


Fig. 16 Narbonne House, Salem, Mass.
 X-ray of present window frame, upper right, showing stud to which frame is attached.

Key to X-ray: 1. Clapboard nails, cut
 2. Lath nails, wrought
 3. Sash lock

There are a few stray nails and broken nails in the stud.

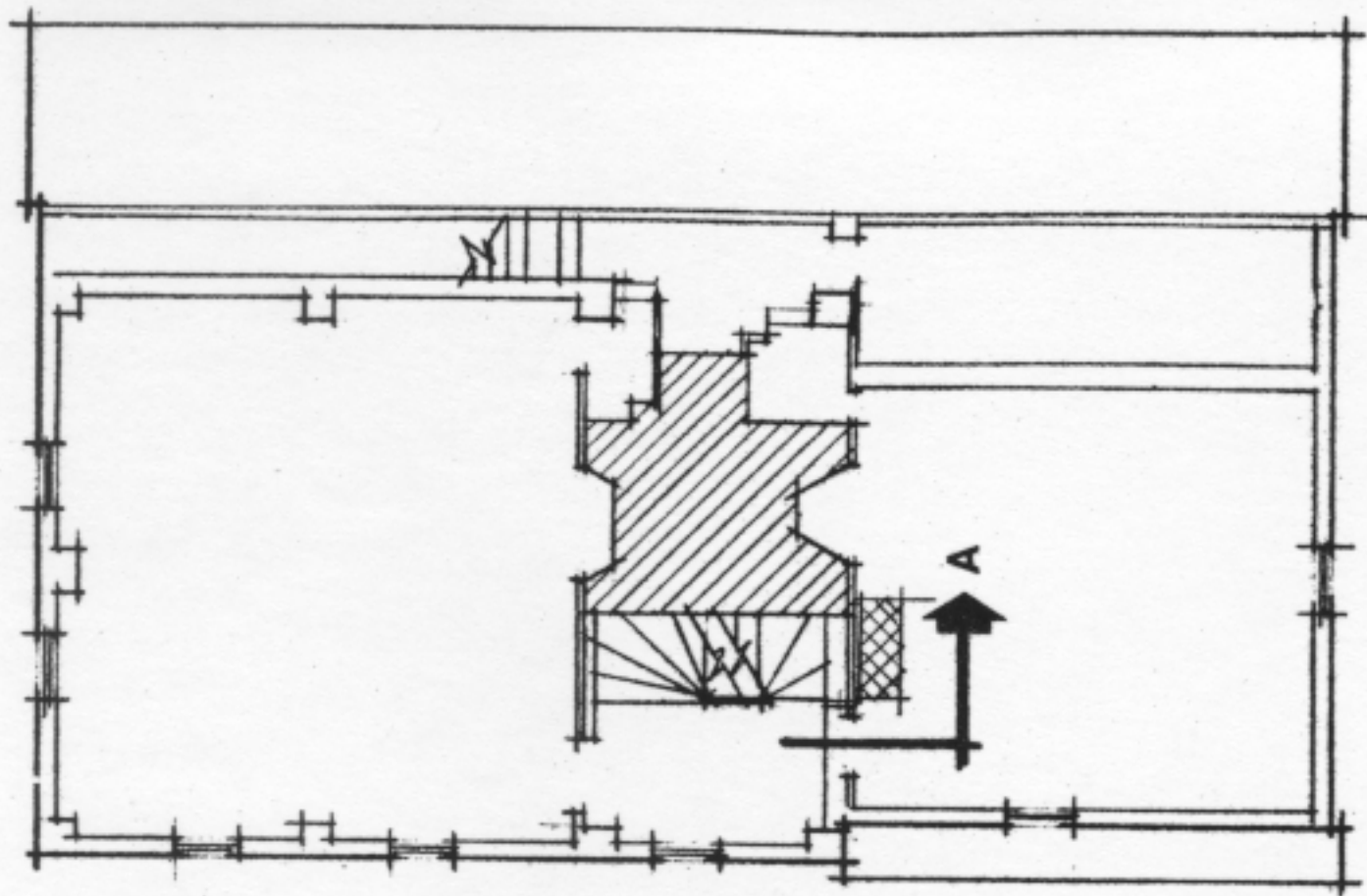


west elevation

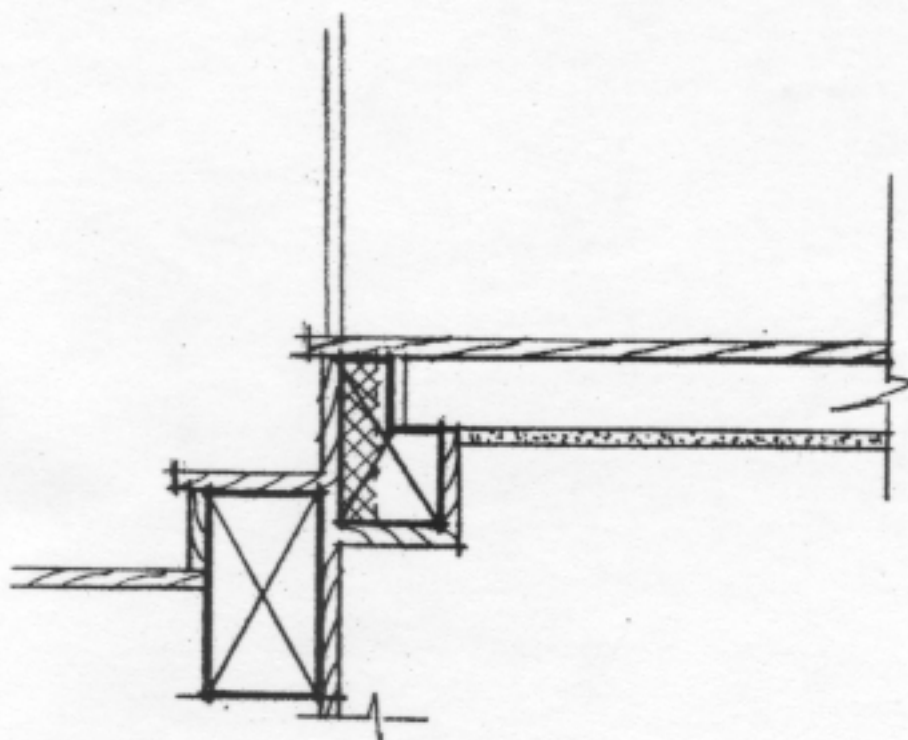
Fig. 17 Composite drawing; cross-hatched areas are those that were examined for evidence of original window frame.

Fig. 18 House from side yard, showing attachment of gambrel addition to north portion.





first floor plan



section A

Fig. 19 Floor plan showing cross-hatched area examined for stud mortices. Section illustrates cut-away portion determined in gambrel girt.

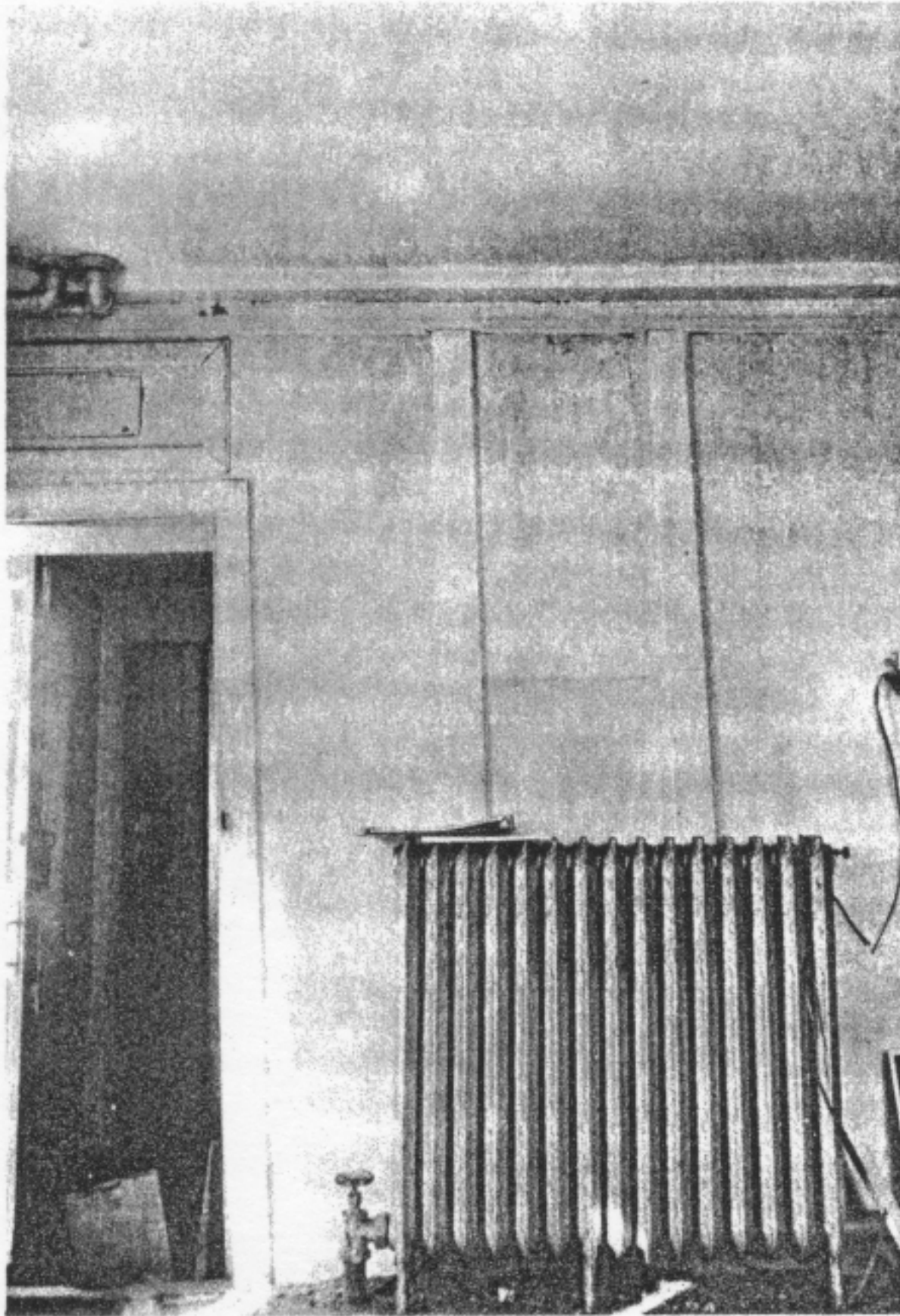


Fig. 20 South parlor, first floor. Area examined for evidence of stud mortices is directly above radiator.



Fig. 21 South chamber, second floor. Area examined for evidence of stud mortices is floor just to left of fireplace.

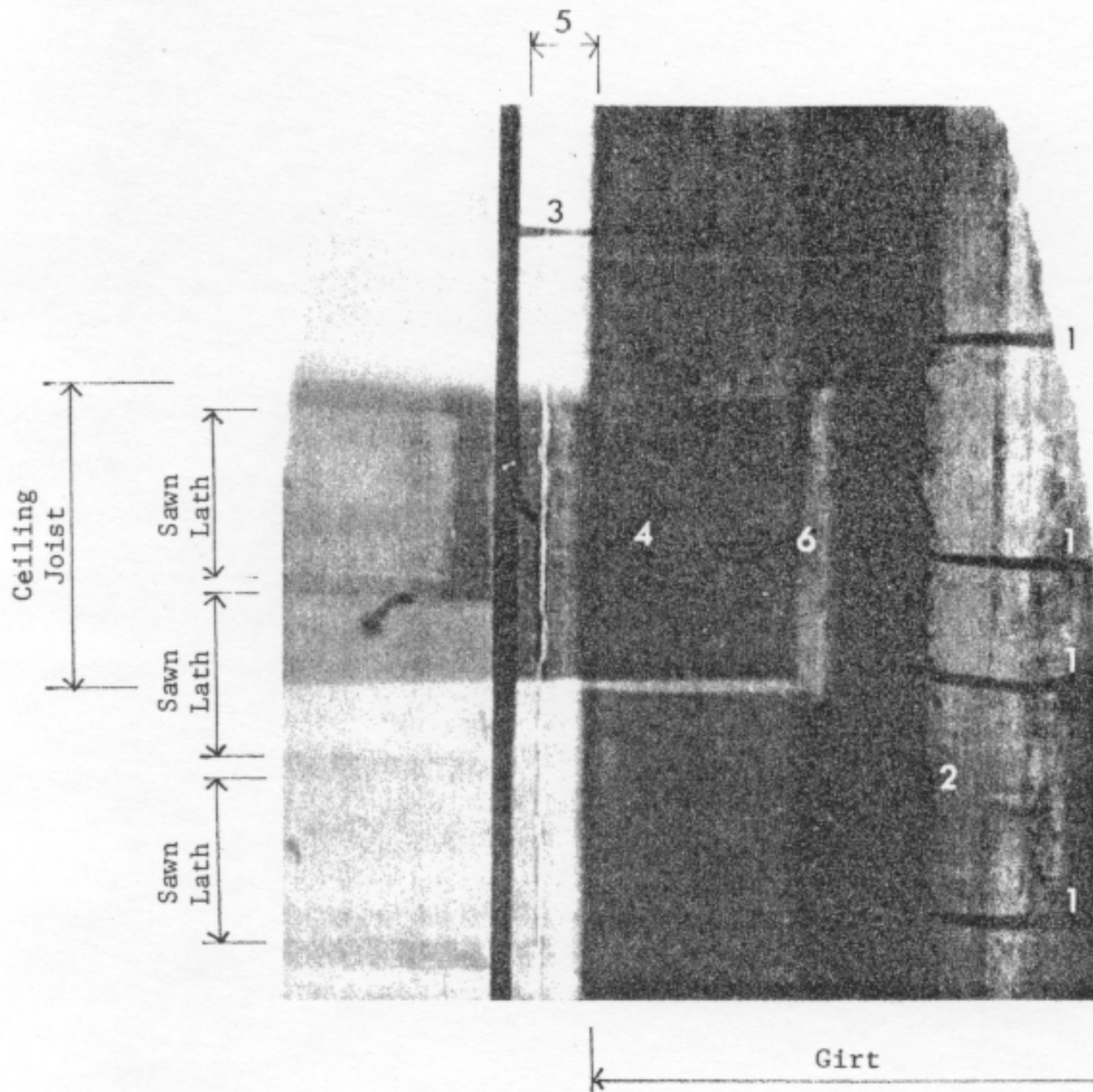


Fig. 22 Narbonne House, Salem, Mass.
 X-ray of areas shown in (20) and (21). Area cut away is seen on right side of X-ray; some large cut spikes also appear in this area. Ceiling joist and mortice are clearly seen.

- Key to X-ray:
- 1. Cut nails
 - 2. Cut-away area of girt
 - 3. Casing nail, wrought
 - 4. Nail, with head flattened
 - 5. Moulding attached to casing
 - 6. Joist mortice