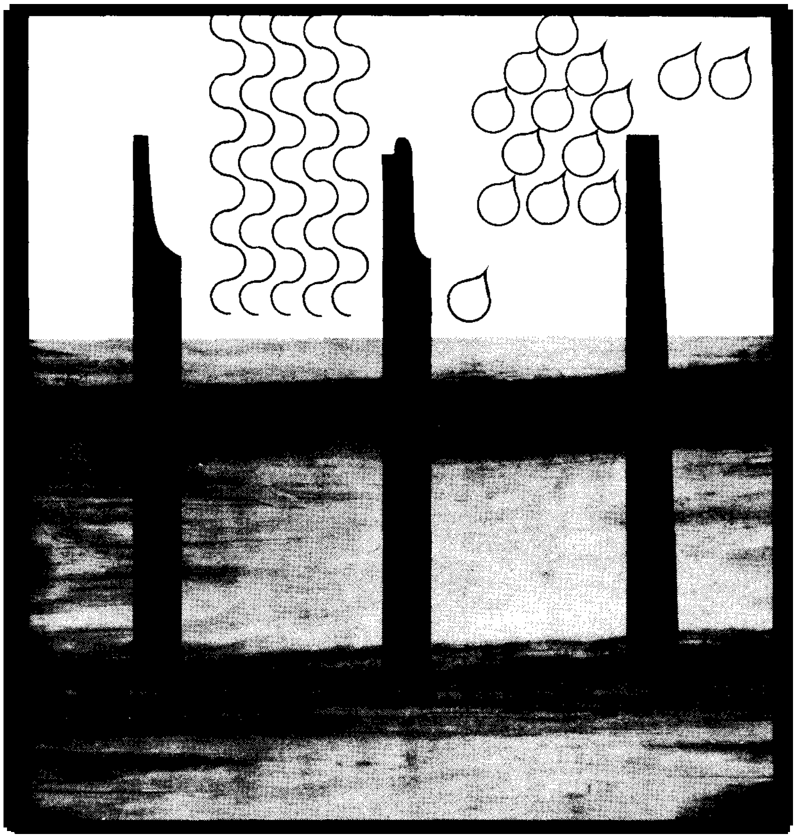
WATER REPELLENTS IMPROVE PERFORMANCE OF DROP SIDING

U.S. FOREST SERVICE
RESEARCH PAPER
FPL 4
MAY
1963



FOREST PRODUCTS LABORATORY
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE - MADISON, WIS.

SUMMARY

A study was made to determine the value of water-repellent preservative treatment in preventing the movement of rainwater to the back face of drop siding. Such moisture is often the cause of paint peeling and results in high maintenance costs. Data from 5 years' exposure of test panels demonstrated that such treatment prevents moisture entry. The study also indicated that a matched (tongued-and-grooved) joint was more effective in preventing water entry into untreated siding than was siding with shiplap joints. Paint retention was noticeably improved on flat-grain siding of treated panels in certain species.

WATER REPELLENTS IMPROVE PERFORMANCE OF DROP SIDING

by

L. O. Anderson, Engineer

Forest Products Laboratory,[1] Forest Service

U.S. Department of Agriculture

INTRODUCTION

Wood siding remains the most popular exterior wall covering used on homes and other wood frame structures. In various forms, wood siding has withstood the effects of time; some sidings still provide good service after several hundred years' use.

Siding applied horizontally is produced in two general patterns: bevel and drop. Bevel siding is usually applied over some type of sheathing. It has horizontal lap joints with the thicker butt edges of the upper courses lapping the thinner top edges of the lower courses. Exposure distance can be changed by varying the amount of lap. Drop siding has a flat back surface and a constant exposure distance because the edges of the siding are matched or shiplapped. Furthermore, drop siding is normally utilized without benefit of sheathing. Sheathing paper is often used to minimize air infiltration.

The use of paint as a finish on wood siding for houses has sometimes resulted in paint peeling, which is often improperly attributed to the wood itself. Poor performance of paint on siding can usually be traced to the presence of moisture in one form or another. Condensation of water vapor (from the interior of the house) on the back face of the siding is one source of moisture. Rain entering joints and siding laps directly or by capillary movement is another way. Both are often the cause of paint peeling or staining of the exterior surfaces. When moisture-sensitive paints are used, unnecessary costs can result because of the need for frequent repainting.

Vapor barriers resist water vapor

[1] Maintained at Madison, Wis., in cooperation with the University of Wisconsin

movement from the interior of a house. A water -repellent dip for the siding can resist entry of rain to the back face of the siding. Laboratory experiments were conducted on lap siding treated in this manner in 1953 with outstanding results. These results are contained in Forest Products Laboratory Report No. 1990.[2] Because little information was available on the effectiveness of this type of water -repellent treatment after long exposures to the weather and because drop siding was not included in the original study, further research was initiated. This new research included three commonly used drop siding patterns and involved treated and untreated siding in three species of wood. The study also covered exposure of the various types of siding to a 4-hour spray test, which was followed by an extended outdoor exposure.

The drop siding, in panel form, was erected to form one side of an exposure unit. Panels were subjected to five full. years of outdoor exposure, from the fall of 1957 through the fall of 1962. During this period, data on moisture entry were obtained after 21 rainfalls; This report covers the results of both the laboratory and outdoor phases of the study.

Panel Details

The three standard types of drop siding used in the study were: (1) rabbeted pattern (Western Pine Association No. 105); (2) dressed and matched pattern (WPA No. 106); and (3) rabbeted bevel drop siding (WPA Dolly Varden), table 1. After all the siding was cut to a length of approximately 34 inches, the siding to be treated was given a 10-second dip in a commercial water-repellent preservative. The siding was then nailed, with galvanized nails, directly to the framework that consisted of 2- by 4-inch studs spaced 16 inches on center. The panels were approximately 5 feet in height. After the water repellent dried for 48 hours, the panels were given one coat of a zinc -free oil-base primer, followed by a commercial oil-base paint with titanium, lead, and zinc pigments.

Nine panels were included in the exposure study--three treated and six untreated. Details of the panels and treatment are outlined in table 1.

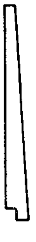
Exposures

Laboratory Spray Exposure

The first exposure phase of the study consisted of a water spray on each of the nine panels. To duplicate seasonal changes, the panels were first subjected to high and low relative humidities by storage at a condition

[2] Teesdale, L. V. Water-repellent preservatives reduce rain-caused paint blistering on wood siding. Forest Products Laboratory Report 1990, 14 pp., illus., 1959.

Table 1.--Details of test panels

Panel description		Panel key No.	Treatment prior to painting[1]	Backing[2]
Siding type pattern	Species, size			
 Rabbeted, No. 105	Southern pine 1 by 6 inch	A-1	None	None
		A-2	Yes	None
		A-3	None	Yes
 Matched, No. 106	Douglas-fir 1 by 6 inch	B-1	None	None
		B-2	Yes	None
		B-3	None	Yes
 Rabbeted, beveled Dolly Varden	Western red-cedar 1 by 8 inch	C-1	None	None
		C-2	Yes	None
		C-3	None	Yes

[1] Ten-second dip treatment in commercial water-repellent preservative.

[2] One panel in each group (No. 3) backed with 4-mil clear polyethylene to aid in revealing any condensed moisture.

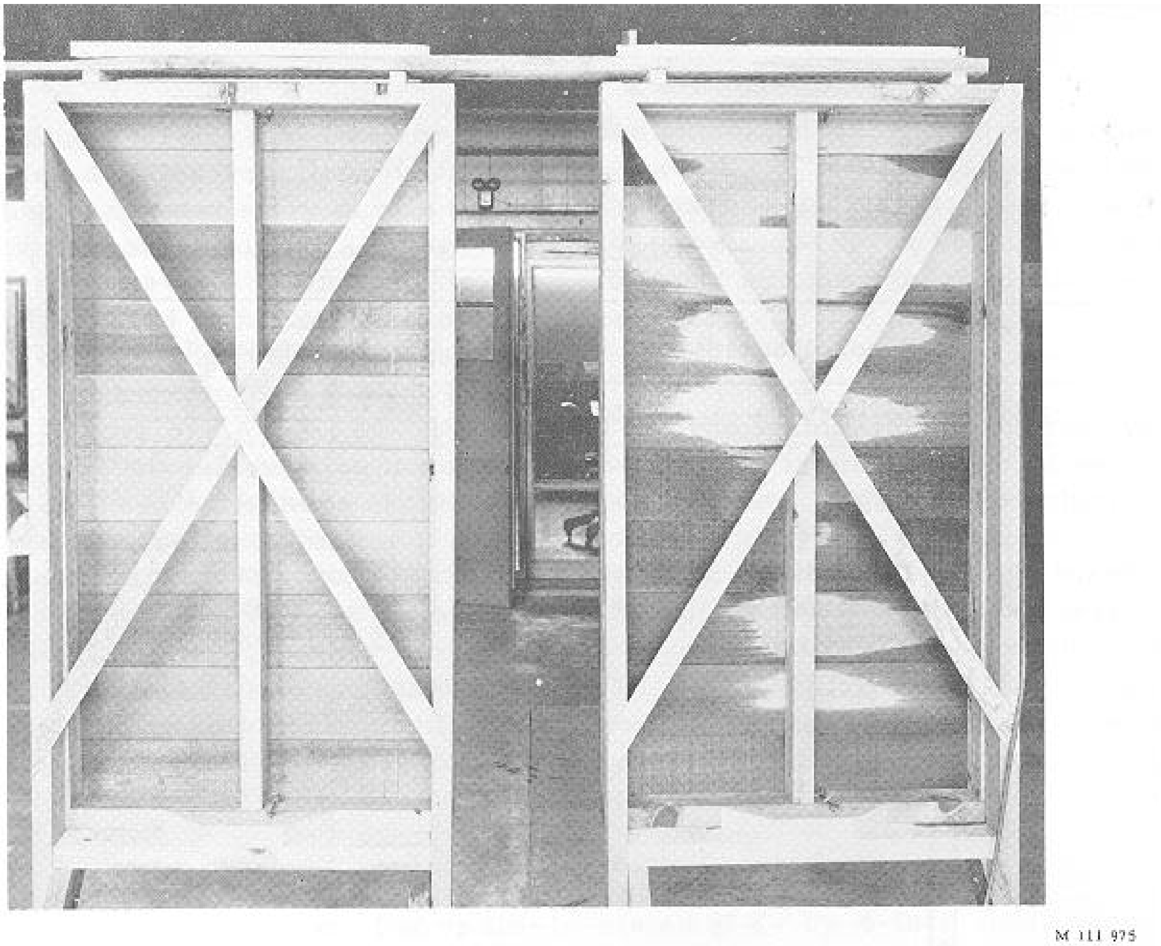


Figure 1.--View of the back (observed area) of two typical exposure panels, showing how the panels were constructed. Spray was directed on the painted face of the panels for 4 hours and the amount of water penetration noted

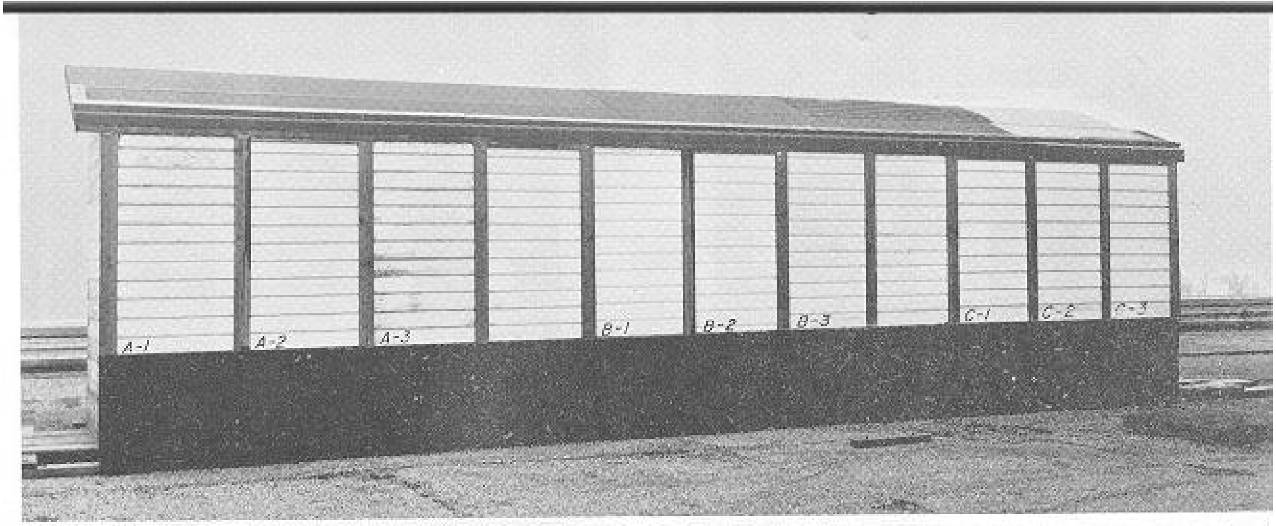
of 120° F. and 85 percent relative humidity for 1 week and then at 120° F. and 40 percent relative humidity for another week. In essence, this swelling and shrinking of the siding placed stresses on the paint film at the siding joints and caused "breaks" that could allow moisture entry.

Panels were then subjected to water spray directed at the painted sides for 4 hours. The back face of each panel was examined during and after the spray period to determine the amount of wetted area, figure 1.

Outdoor Exposure

Following the spray exposure, the nine siding panels were combined to form one side of an enclosed outdoor exposure unit. This unit was placed on the roof of the Forest Products Laboratory building, in the fall of 1957, so that all test panels faced south, figure 2. As noted, no cornice was included allowing rain runoff from the roof to cover the panel faces. The edges of each panel were sealed by calking and by a casing placed over the joint.

The observed area on the inside face of each panel consisted of the back surface of the drop siding between the studs. Each of these two areas was 14-1/4 by 56-1/2 inches, or a



M 128 446

Figure 2.--View of outdoor-exposure unit. The groups of three test panels face south and are separated by a nontest panel. Panels A-2, B-2, and C-2 are treated with a water-repellent preservative. No cornice was included on the unit.

total of 1,610 square inches. Data (square inches of wetted area) were usually obtained after rainfalls that were sufficient to produce wetting on the back face of any of the panels.

Readings were taken near the end or shortly after rainfalls that occurred during the normal work week. Figures 3, 4, and 5 show the interior of the panels after a rainfall.

Discussion of Results

Laboratory Spray Exposure

After the 4-hour water spray, there was no evidence of moisture penetration to the back face of any of the three treated panels. Nor was there any weight increase to indicate the absorption of water.

Untreated shiplap drop siding (A-1 and A -3 panels), had moisture showing on the back face and also each panel averaged almost 1/2 pound gain in weight.

Untreated matched pattern drop siding (B-l and B-3 panels) had very slight evidence of moisture penetration and no noticeable gain in weight.

Beveled and rabbeted untreated siding (C-l and C-3 panels) had large wet areas and averaged more than 1 pound gain in weight.

Although these spray exposures were of relatively short duration there was indication of the value of a water-repellent preservative dip treatment. However, it was felt that the exposure did not establish definite trends. A long-time outdoor exposure would be required to provide more complete data.

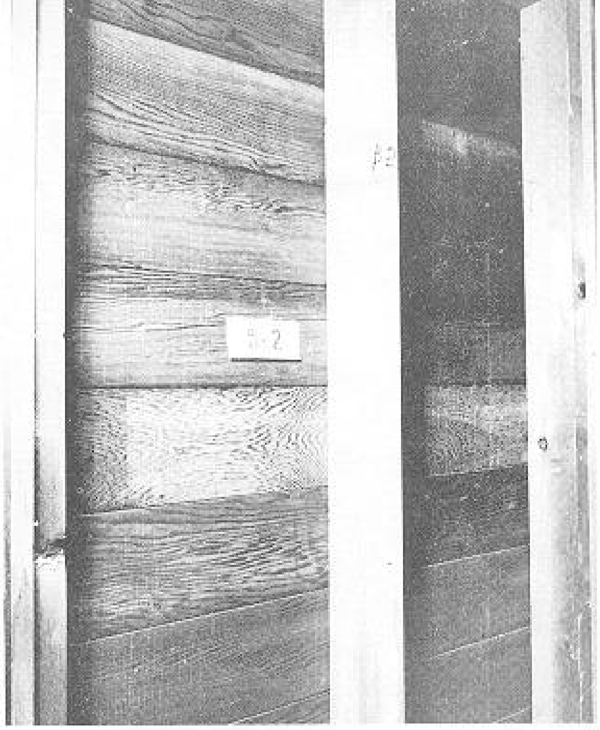
Outdoor Exposure

After 5 years' exposure to all types of weather conditions, various performance trends were observed.

Light and moderate rains of short duration usually were not sufficient to allow moisture to migrate to the back face of untreated panels. Normally it appeared that the length of the rainfall was the primary factor

Figure 3. --Inside view of panels A-l, A-2, and A-3 after a rainfall. Panel A-l (southern yellow pine drop siding, rabbeted pattern, not treated) shows water entry that was from the lap, usually extending on each side of the horizontal joint. On panel A-2 (southern yellow pine, rabbeted pattern drop siding, dip treatment in water-repellent preservative), no moisture was noted on the back face during the entire 5-year outdoor exposure period or during the initial laboratory spray exposure. On panel A-3 (southern yellow pine, rabbeted pattern, untreated drop siding with a polyethylene cover), moisture entered at the horizontal siding joints. White portions are indications of mold. Note: The use of polyethylene permitted accumulation of the observed amount of condensed moisture.

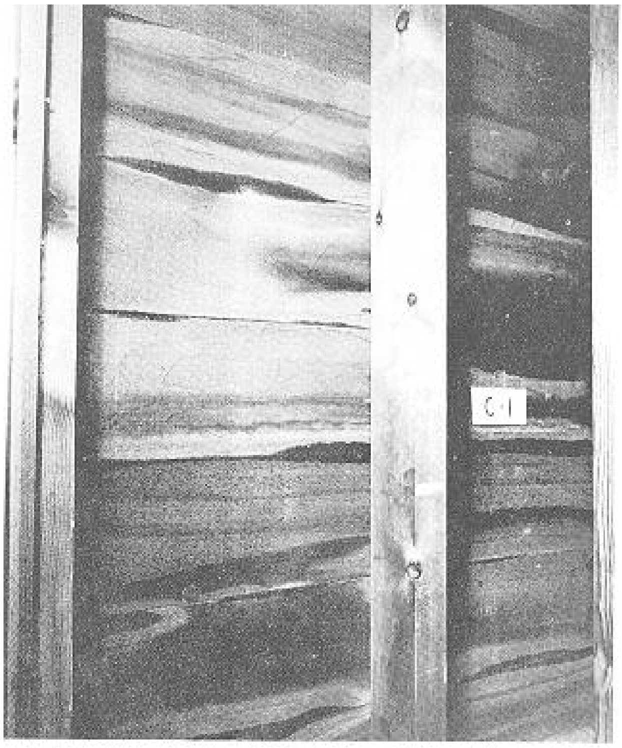
M 118 450



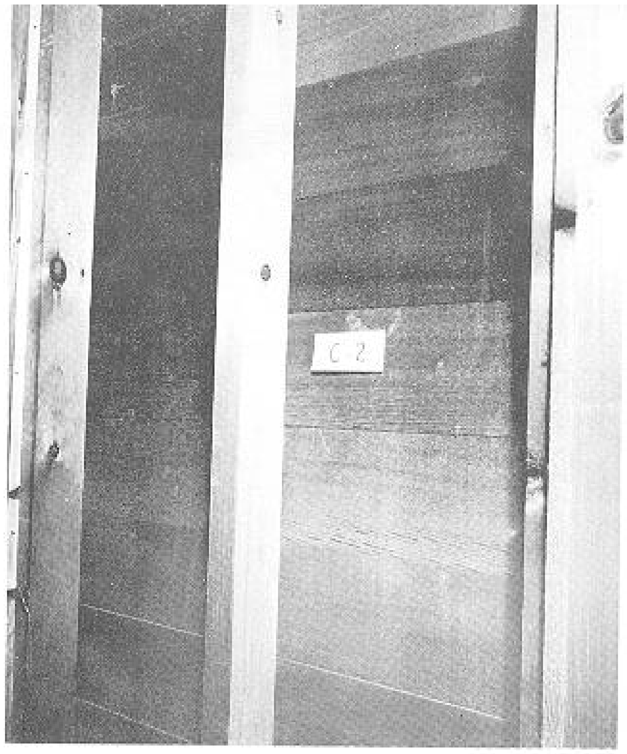
M 118 451

M 118 452

Figure 4.--Inside view of panels B-1, B-2, and B-3 after a rainstorm. On panel B-1 (Douglas-fir, matched pattern drop siding, untreated), water enterted at lap joints and spread along inside faces of siding Note flat gram of siding On panel B-2 (Douglas-fir, matched pattern, treated), the back face of the panel was free of moisture On panel B-3 (Douglas-fir, matched pattern, untreated, polyethylene cover), rainwater entered through siding laps and was retained long after similar panels without covering had dried off.



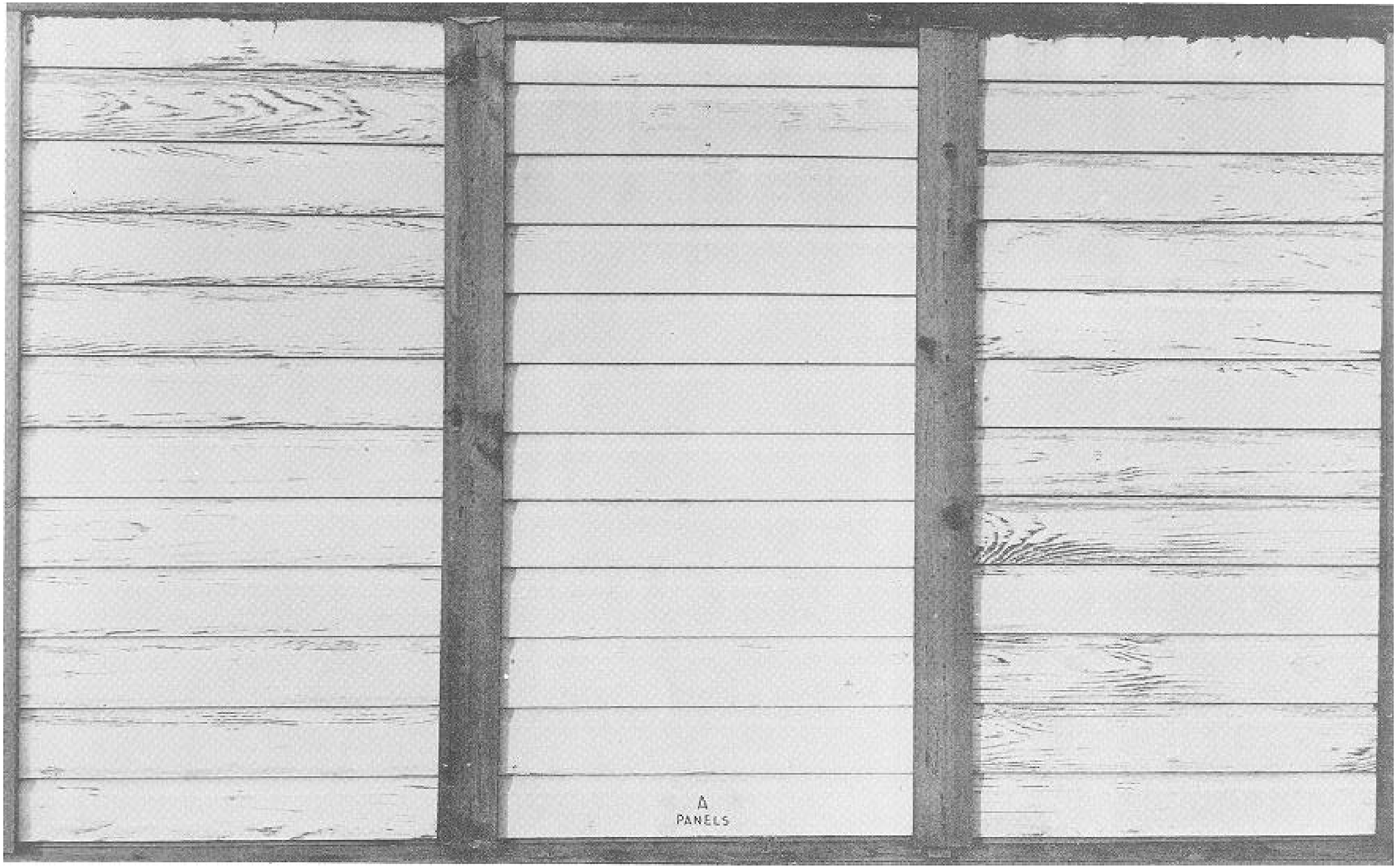
M 118 453



M 118 454

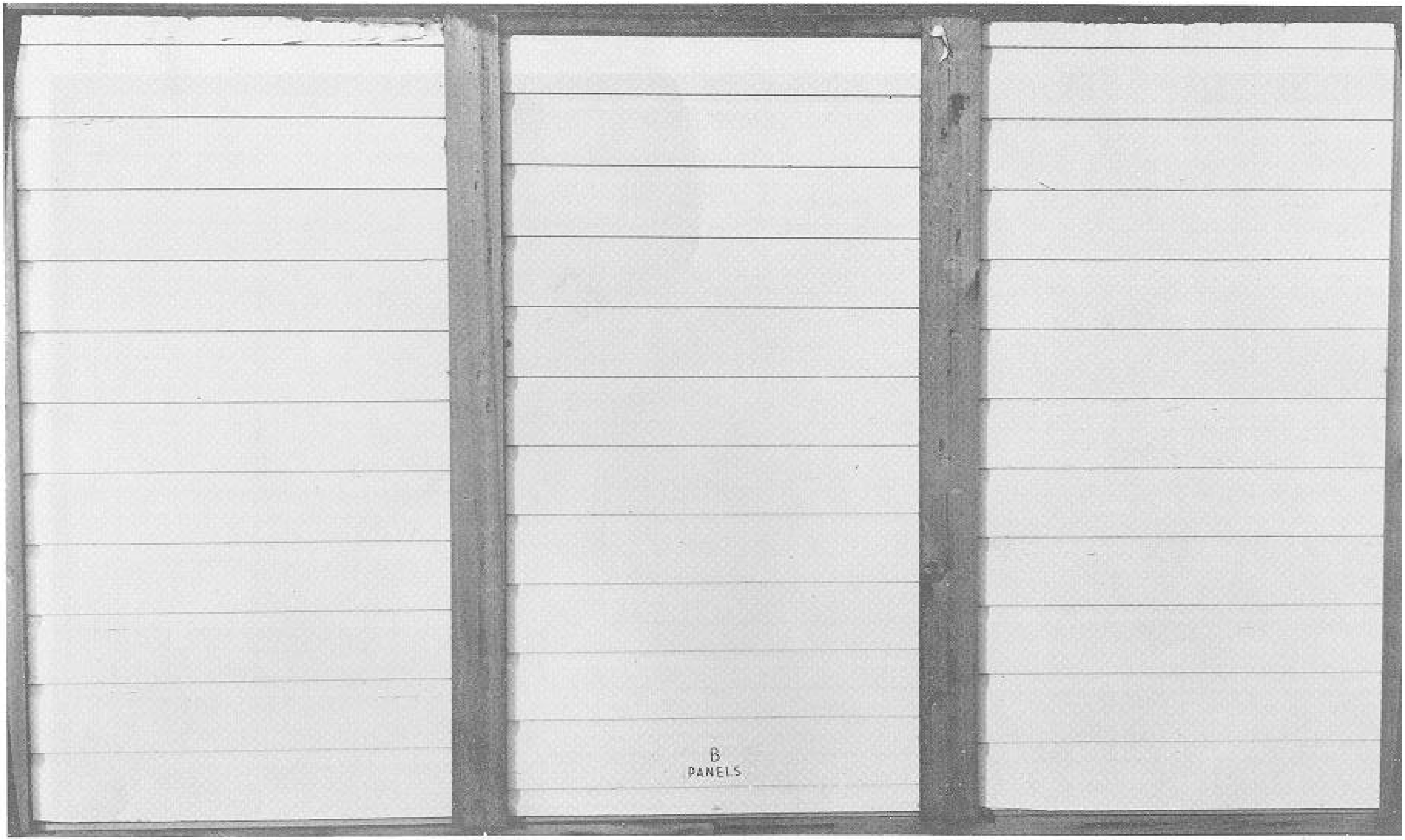
M 118 455

Figure 5. --Inside view of panels C-1, C-2, and C-3 after a rainfall. After long rains, the back face of panel C-1 (western redcedar, rabbeted pattern, untreated) had large wetted areas. No moisture was present on the back faces of panel C-2 (western redcedar, rabbeted pattern, treated). On panel C-3 (western redcedar, rabbeted pattern, untreated, polyethylene cover), the wetted areas can be noted under the film.



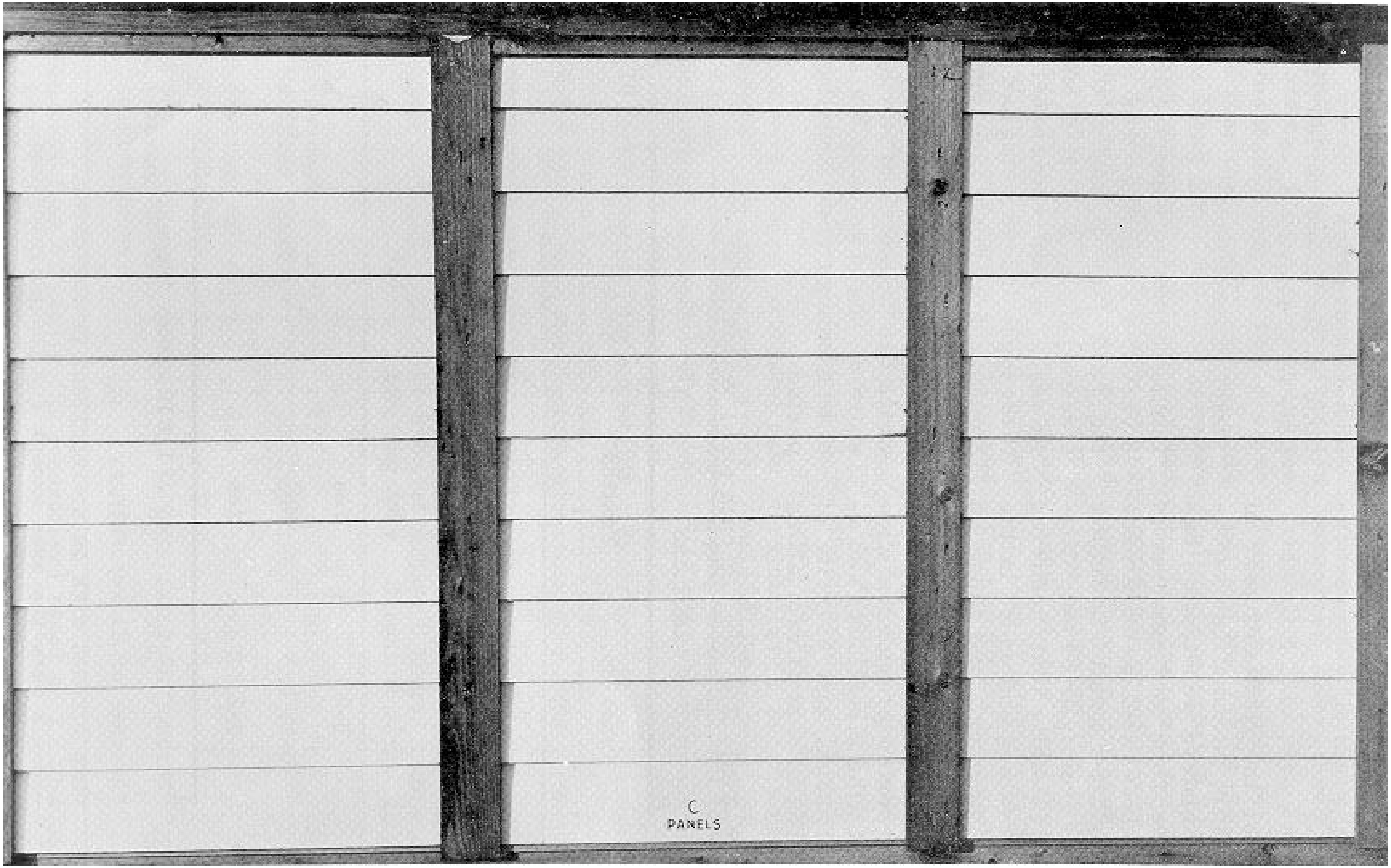
M 118 667

Figure 6. --Exterior view of panels A (southern yellow pine) (left A-l, center A-2, and right A-3) Center panel was treated and end panels were untreated. The difference in paint retention can be noted. All siding was flat-grained. Panels had been exposed for 3 years



M 118 668

Figure 7. --Exterior view of panels B (Douglas-fir) (left B-1, center B-2, and right B-3). A slight improvement in the paint retention of the treated panel, center, can be noted over the adjoining untreated panels. All panels had flat-grain siding. Panels had been exposed for 3 years.



M 118 669

Figure 8.--Exterior view of panels C (western redcedar) (left C 1, center C-2, and right C-3). There was little or no difference in the paint retention of the center treated panel from that of the adjoining untreated panels. All siding was edge grain, which is probably the primary reason for better performance, as dimensions do not change as much as flat-grain siding during seasonal moisture changes.

in the penetration of moisture. The severity of the rainfall was a secondary factor.

During 1958, the first full year of exposure, little information was obtained on moisture penetration because of the time and amounts of rainfall. Unless readings were made immediately after a rainfall, lightly wetted areas usually dried out. Consequently, rainfalls that occurred during the evening and ended in the very early morning, and those on weekends were not recorded. However, the 21 data readings made over the 5-year period provided a wide variation of wind directions, and amounts, duration, and severity of rainfalls. The amount of rain falling during each storm varied from 0.4 inch to more than 3 inches. Durations of the rains varied from 1/2 hour to 30 hours.

Effect of treatment

During the entire exposure period of 5 years, no moisture was noted on the back face of any of the three treated panels, A-2, B-2, and C-2. However, the untreated panels of the three types of drop siding had varying amounts of moisture appearing on the back faces after each rainfall. Table 2 lists the average area, in percent, which had become wet during rainstorms. Each value is the average of 21 readings made over the 5-year period.

Table 2.--Area[1] of each panel wetted after each rainfall[2]

Panel No.	Treated[3]	Wetted area
		Percent
A-1, A-3	No	[4]14.2
A-2	Yes	0
B-1, B-3	No	[4]4.6
B-2	Yes	0
C-1, C-3	No	[4]25.9
C-2	Yes	0

[1]Percent of total area of 1,610 square inches.

[2]Average of 21 recordings.

[3]Dip treated with water-repellent preservative.

[4]Panels were the same except for the polyethylene backing so areas were averaged.

Effect of siding pattern

The matched pattern of untreated drop siding, B panels, resisted the movement of moisture to a greater extent than the A and C panels. This tongued-and-grooved material had an average wet area of only 32 percent of that of the rabbeted A panel siding and 18 percent of that of the rabbeted and beveled C panel siding. This indicated that the tongued-and-grooved form of the matched pattern provided greater resistance to capillary and direct movement of water through the siding joints and would be likely to perform well in service.

Duration of Rainfall

As expected, longer periods of rainfall resulted in larger wet areas. This was often true although the rainfall was sometimes relatively light. Often heavy showers of short duration (10 to 15 minutes) did not result in water penetration. Table 3 shows the average amount of wetting that occurred after three durations of rainfall. The wet area averaged from 2.5 percent for the matched pattern No. 106 (B panels) for rainfalls no greater than 3 hours in length to 38.1 percent for Dolly Varden pattern (C panels) for rainfalls longer than 8 hours. These percentages also indicated the better performance of the tongued-and-grooved (matched) joint of the B panels over the shiplapped joint of A and C panels.

Amount of Rainfall

The relation of the amount of rain to the amount of wet area must also be considered. As shown in table 4, rainfalls of 1/2 inch or less produced only slight wetting. Rainfalls averaging from 1/2 to 1 inch produced 3 to 4 times the amount of wetted area which occurred after the lighter rains except for the matched pattern

Table 3.--Wetted area for various durations of rainfall (untreated panels)

Panels and joints	Average percent of wetted area[1]: 0 to 3 hours' duration	3 to 8 hours' duration	Over 8 hours' duration
A (average of two) shiplap joint	4.7	10.8	23.6
B (average of two) matched joint	2.5	2.8	7.7
C (average of two) shiplap joint	11.5	22.4	38.1

[1]On back face of panels (21 recordings.) based on 1,610-square-inch test area for each panel.

Table 4.--Wetted area for various amounts of rainfall during each recorded storm untreated panels

Panels and joints	Average percent of wetted area[1]		
	0 to 0.5 inch of rain	0.5 to 1.0 inch of rain	Over 1 inch of rain
A (average of two) shiplap joint	4.0	11.2	23.7
B (average of two) matched joint	1.8	3.7	7.4
C (average of two) shiplap joint	6.8	25.5	37.5

[1]On back face of untreated panels.

B. Two rainfalls with durations of over 24 hours and amounts over 2 inches resulted in average wetted areas of 37, 13, and 70 percent for untreated panels A, B, and C, respectively.

Effect of Wind Direction

The wind direction was not significant in determining the amount of wetted test area. All panels faced directly south and most rainstorms occurred during a southeast to a southwest wind. Table 5 gives the percentage of wet area when winds were toward the test panels compared with results when winds were in the opposite directions. Since there was no cornice on the exposure unit to protect the panel faces, wind direction whether directed toward the panels or from a northeasterly to a northwesterly direction did not influence the amount of moisture penetration. Roof runoff was apparently sufficient to keep the outer surfaces of the panels wet.

The Effect of Backing (Sheathing Paper)

As outlined in table 1, panel No. 3 in each of the three types of siding had a polyethylene sheet on the back of the siding to aid in detecting moisture which could condense on the film. Moisture which had penetrated one of the panels was retained long enough between rainfalls to cause mold on the back surface of one panel. Figure 3, the interior of panel A-3, shows the white mold on the back of the siding. Alternate wetting and drying such as this could cause decay under adverse conditions. The advisability of using a sheathing paper other than a breathing type behind untreated drop siding is questionable. This, in effect, was concluded in studies by A. F. Ver-

Table 5.--Effect of wind direction on moisture penetration (untreated panels)

Panels and joints	Average percent of wetted area[1]	
	ON (wind on face of test panels)	OFF (wind not on face of test panels)
A (average of two) shiplap joint	12.8	13.1
B (average of two) matched joint	3.7	4.4
C (average of two) shiplap joint	23.0	24.6

[1]On back face of untreated panels.

rall.[3] In his extended study, fewer decayed siding boards were evident when drop siding was backed with a breathing paper or did not have a backing.

The Effect of Treatment on Paint Holding

Not originally a part of the project, some data were obtained on the value of the water -repellent preservative in holding the paint on the dense summerwood of certain species. This is evident on the southern yellow pine panels, figure 6. The center panel was treated and end panels, A-1 and A-3, were untreated. There was somewhat better retention on the treated Douglas-fir panel B-2, in the center of figure 7, than on the adjacent untreated panels. Whereas these were matched (tongued-and-grooved) panels, not so much moisture had reached the back face as in panels A. Both A and B panels contained flat-grain siding.

Although the C panels of western redcedar had a great deal of moisture penetrating to the back faces, the value of the water-repellent preservatives in retaining the paint was not evident, figure 8. Both treated (center) and untreated panels (each side) performed well. However, the siding was all edge grain and therefore more stable during moisture changes. This is probably the primary reason for good paint-holding ability whether panels were treated or not as the backs of the panels were wet after almost every rain.

[3]Verrall, A. F. Wood siding in the South. Forest Products Jour., Vol. X, No. 3, March 1960.

Conclusions

Based on the results of the 5-year study of treated and untreated drop siding, the following conclusions are made;

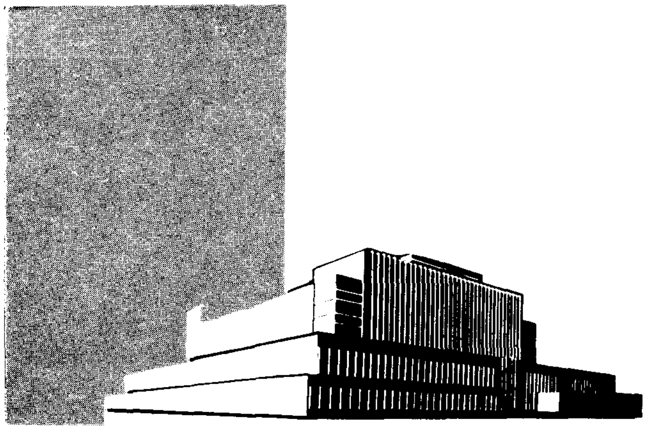
1. The use of a dip treatment of water-repellent preservative for drop siding will eliminate or greatly minimize the entry of rain to the back face. This would reduce paint peeling which often results from such sources of moisture. This applies to most types of matched, shiplapped, and lapped joints.

2. The matched pattern (tongued-and-grooved) was definitely superior to the shiplap pattern in resisting moisture movement to the back face of untreated siding. This type of drop siding would probably perform well in service.

3. Improved paint retention can be expected on drop sidings that are treated with a water-repellent preservative. This applied to flat-grain siding of species that have contrasting springwood and summerwood. This improved performance is not apparent in edge-grain siding,

4. The use of vapor-resistant sheathing paper behind untreated drop siding is a questionable practice. Moisture entering the back face of the siding dries out slowly and under certain conditions can cause decay. It is believed that if a paper backing is required to minimize wind infiltration in unsheathed walls, the paper should be partially absorbent so that moisture could more easily evaporate between rainfalls.

2. -19



FOREST PRODUCTS LABORATORY
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE - MADISON, WIS.

In Cooperation with the University of Wisconsin