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Wood-Boat Maintenance

Decay and Its Prevention

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Accidental damage to the hull, marine-borer attack, and fungal decay are the commonest reasons for repairing wood boats. Physical damage and marine-borer attack are usually obvious, but decay is not *easy to detect. Knowing the causes of decay helps in recognizing its effects, hopefully early enough to avoid the need for expensive repairs.*

What is rot and what is not

Fungi — parasitic plants — are the culprits that cause rot. Their actively growing filaments penetrate wood, sometimes becoming visible to the unaided eye as strands or layers of fungal threads, and cause decay. They occasionally produce visible fruiting bodies, called "conks" or "brackets," that distribute their reproductive spores.

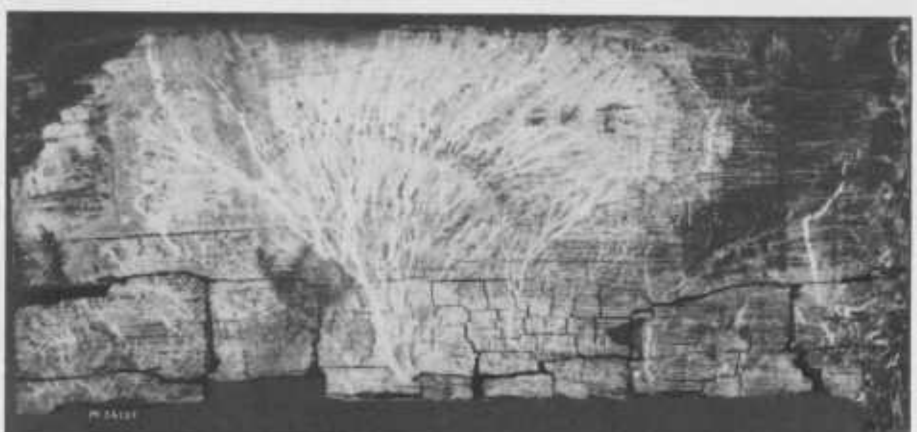
Moisture and temperature. The spores from fungal fruiting bodies spread virtually everywhere. Wood with sufficient moisture content and temperature is likely to provide a hospitable substrate and begin to decay unless it is naturally very resistant or is thoroughly protected with a preservative. For most situations, the cheapest and best way to protect wood is to keep it dry.

Yet even when it looks and feels dry outside, if the *moisture* content is 25 percent or more of the weight of the ovendry wood, it can decay rapidly. *Thus, there is no such thing as "dry rot."* Decay never takes place if the moisture content remains below 20 percent.

On the other hand, too much moisture is unfavorable for fungi; they need air as well as water, and the common decay-producing fungi are unable to work in waterlogged wood. On boats constantly in the water, the keel and other members below the usual bilge-water level are generally too wet to decay and are rarely damaged by fungi.

Most fungi can grow at any *temperature* between 5° and 38° C, producing decay fastest in the neighborhood of 24° to 30° C. Although periods of extreme cold halt decay, they do not kill fungi, which resume activity as temperatures rise. High temperatures, however, such as those reached in kiln drying or in steam treatment for bending, kill fungi but do not prevent reinfection after the wood has been placed in service.

The water line. Most decay in boats in salt water occurs *above the water line,* where water can enter but not evaporate—at joints and seams, particularly where end grain is exposed. It is difficult to keep joints at bases of stanchions tight,



"Mycelial fans" of fungal filaments are evidence of advanced decay. Fans are usually found between adjoining wood surfaces in damp, dark areas. Poor ventilation? Trapped moisture? (Photo courtesy U.S. Forest Products Laboratory, Madison, Wis.)

Fungal fruiting bodies on decaying wood produce billions of microscopic spores that can attack unprotected, moist wood.

13½ = 40ch 8/9 28½ = 77ch 9/10 Helv 85ch 8/9 Helv 43½ = 130ch 8/9

as well as seams and butts at the waterways; accordingly, the planksheer, the frame heads or top timbers, the outer ends of deck beams, and the bases of stanchions are attacked rather frequently by fungi.

Joints between hull planking and transom and counter members provide other favorable locations for decay. Unventilated holds, areas outboard and beneath these holds, and compartments such as chain lockers at stem or stern are also susceptible to fungi.

Hull planking most often decays at the butt blocks or along the edges of seams. Both planks and frames are likely to decay on the faces where they cross. Hatch coamings and other exposed deck structures decay at joints.

In fresh water (in addition to decay points listed above) interior members *below the water line* are often decayed; keels are rarely affected by fungi, except on boats that are hauled out for considerable periods in warm weather.

How long does it take? No simple average can be given for the time required for decay to become serious. If sapwood is heavily infected under conditions favorable to fungal growth, small pieces can decay thoroughly in three months. Yet the heartwood of some species of trees is nearly immune to attack. *Use of suitable types of wood is all-important* (see "What kind of wood?" below).

Extensive repair of rot has become necessary in some boats within just two to three years.

What it's not. Damage by decay-producing fungi may be hard to tell from that by other agents, including:

1. marine boring mollusks such as *Teredo* and *Bankia*, which make large tunnels inside wood; or crustaceans called "gribble" or *Limnoria*, which make numerous, very small tunnels just below the surface of wood, gradually reducing the size of the wood member (both of these marine animals — which, incidentally, cannot survive long in fresh water—can at times be more destructive than fungi);

2. black discoloration in wood that frequently is caused by the reaction of tannin in wood with iron fastenings;

3. battery acids, chemical reactions between wood and iron (frequently involving electrolysis), and high temperatures produced by boilers or steam pipes—all of which can cause deterioration of wood that closely resembles decay;

4. termites that may be associated with fungal decay; and

5. alternate contraction and expansion from freezing and thawing of wet wood (plus other physical forces), which can do damage, causing the annual rings in wood members to separate, gradually eroding away wood fiber.

Factors affecting decay

The most significant practices leading to rapid decay of wood in boats are: (1) the use of untreated, nondurable wood (especially sapwood) where it is exposed to humid conditions or to alternate wetting and drying; (2) inadequate ventilation and drainage; and (3) time spent in harbor.

(Sapwood is the outer, usually whitish portion of a tree, located between the bark and the older heartwood; it is most easily seen in the cross section of a log or in the end grain of a timber.)

In some cases, wood stored in construction or lumber yards has been infected with decay and then used in boat construction. Wood for construction should be stored in well-aerated stacks under cover, where it can be kept dry.

With the exception of using sapwood, no one of these practices by itself should lead to rapid decay, but some boats with bad records probably suffer from all of them. Taking these three practices in order, one could ask first:

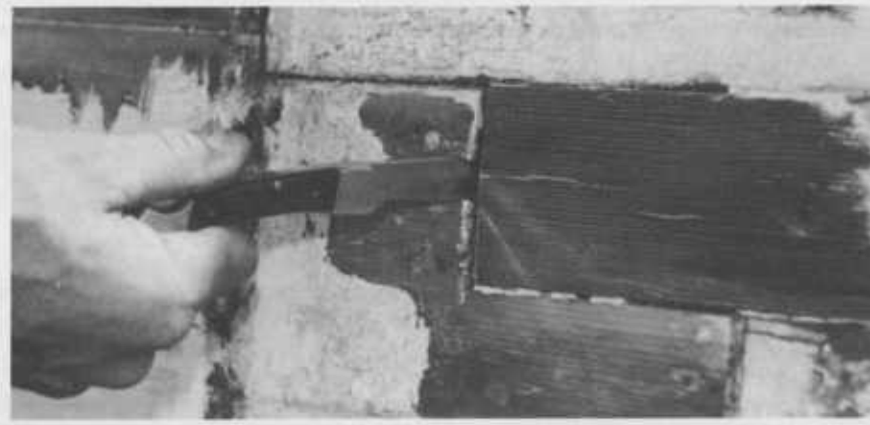
1. *What kind of wood?* No untreated sapwood of any species is decay-resistant; it should be used only where it will be continually dry. Sapwood pressure-treated with preservative, however, will provide long service under the most severe conditions.

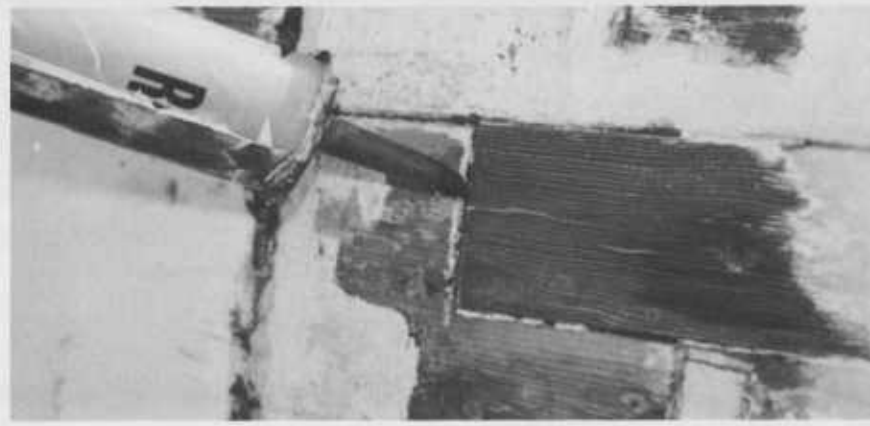
Heartwood of white oak, Port-Orford-cedar, and Alaska-cedar (yellow-cedar) are used in larger boats because of their durability.

Teak, ironbark, greenheart, some mahoganies, and other tropical woods have durable heartwood, but they are not readily available. A word of caution: some tropical woods, such as greenheart, have thick sapwood (marine borers destroyed greenheart piles at Newport, Oregon, within eight years). A further problem is that tropical woods are sold under different trade names, making it difficult to identify and purchase durable-heartwood species.

Douglas-fir heartwood is moderately durable. When used in critical locations on a boat or where replacement is difficult, sapwood *and* heartwood of Douglas-fir, hemlock, spruce, pine, and yellow poplar should be pressure-treated with a standard preservative.

This is an example of decay—serious decay—in a stern timber.





"Before" and "After"—A fisherman probes a moisture trap (above) at a faying surface between the plank ends. After insuring that there is no decay in the seam, he coats the seam with wood preservative, and (below) he calks it to seal out water.

2. *Ventilation and drainage.* Water (rainwater from above or condensed moisture from below) that enters cracks, joints, or other spaces where it can remain for long periods favors decay. It bears repeating that *there is no such thing as "dry rot"*; all fungi require moisture.

Decay is largely confined to the stem, transom area, beneath the planksheer or cover-board, and the bilges in boats with enclosed holds. The headers beneath the cabin and filler blocks also warrant inspection, as do the frame and planking near the water line of hulls that remain for considerable time in fresh water. Inspect chines and decking when boats spend considerable time out of service (see "Get rid of moisture that has entered," page 4).

3. *Time in the harbor.* Boats decay fast when laid up in the harbor. Some fishermen relate that one idle year results in as much decay as five years' service. Why? Presumably, because boats laid up are ordinarily subject to much less drying-air motion and may not be as well cared for: ventilators are probably closed; decks and superstructure are undrained; and seams are allowed to open up.

Five ways to detect decay

Brackets or conks (mushroomlike growths from wood) and white growth on or between wood members are visible signs of decay. Frequently, however, decay proceeds unrecognized until damage becomes extensive. There are five basic ways to detect decay:

1. *Discolored paint or cupping* (indentations) on the wood surface may indicate decay.

2. *Sounding with a hammer* produces a dull sound in infected wood and is particularly useful on timbers that may have decayed interiors.

3. *A sharp ice pick* penetrates decayed wood relatively easily. Slivers of decaying wood turned up by an ice pick or a knife tend to break off short, unlike long-splintering sound wood.

4. *Decayed wood is brittle when dry*, breaks easily across the grain, and may even crumble into powder under pressure. Sound wood is difficult to break.

5. *Drilled holes* are best for inspecting large timbers; drill holes 9 millimeters (or 3/8 inch) in diameter, to no more than one-fourth of the thickness of the timber. The ease with which the drill penetrates and the condition of the chips indicate the soundness of the timbers. Plug inspection holes with tight-fitting dry dowels that have been soaked in a wood preservative, then coated with marine glue prior to being driven into the full depth of the drilled hole. Borings should never be of such a number or so located as to impair the strength of the hull.

Ten ways to prevent decay in wood boats

1. Provide thorough air ventilation and water drainage at all times, whether afloat or in storage.

2. Keep all ventilation terminals open and mechanical ventilation systems operating whenever practicable, for safety as well as to prevent decay.

3. Make sure that drain pipes, scuppers, limbers, and holes near deckhouses and toe rails are unobstructed.

4. Calk deck seams thoroughly, especially in the planksheer area. *Note:* The decay frequently encountered where frames cross planks indicates the hazard at faying surfaces, even where end grain is not involved. An obvious remedy is to keep all seams well calked, especially where end grain is involved. Paint or preserve insides of bolt holes and seams before calking them. Careless use of calking irons (cutting gashes in the surface of the plank) can create moisture traps.

> **Fish Hold Linings**
>
> **are a special case. The preservative you use on wood in fish holds must prevent decay and not contaminate fresh fish. The U.S. Food and Drug Administration advises that copper-8-quinolinolate may be safely used on fish hold linings. See your marine advisory agent for further information.**

Water commonly enters around nails, exposed bolts, and other fastenings; countersink heads of bolts and close fastener openings tightly with wooden plugs to prevent this. In small boat work, for through-fastenings, such as screw bolts, use grommets under the heads to insure tightness. Keep metal fastenings of all sorts tight.

5. Repair work sometimes puts sound wood against infected wood. This is especially likely to cause sound wood to decay unless it is well impregnated with an effective preservative; surface treatments give partial protection in such a situation. Allow infected members to remain in place during repairs *only* if plans call for a short term of service, for eliminating leaks, or for improving ventilation—so that the wood will stay dry in the future.

6. When sanding decks, preserve the proper camber and eliminate low spots that would allow water to accumulate.

7. In fair weather, open hatches and deck plates of wood boats to supplement the air circulation provided by the stationary or mechanical ventilators. Check for leaks beneath the planksheer and deckhouse.

8. In fair weather (when in harbor), remove wet dunnage from lockers and dry it.

9. Thick coats of paint trap moisture; apply thin coats. Maximize the use of wood preservatives on other than "weather" surfaces of your hull.

10. Use fenders or rubber tires between your boat and other boats, piers, or mooring docks to prevent damage to boat sides—another potential source of "rot."

Get rid of moisture that has entered

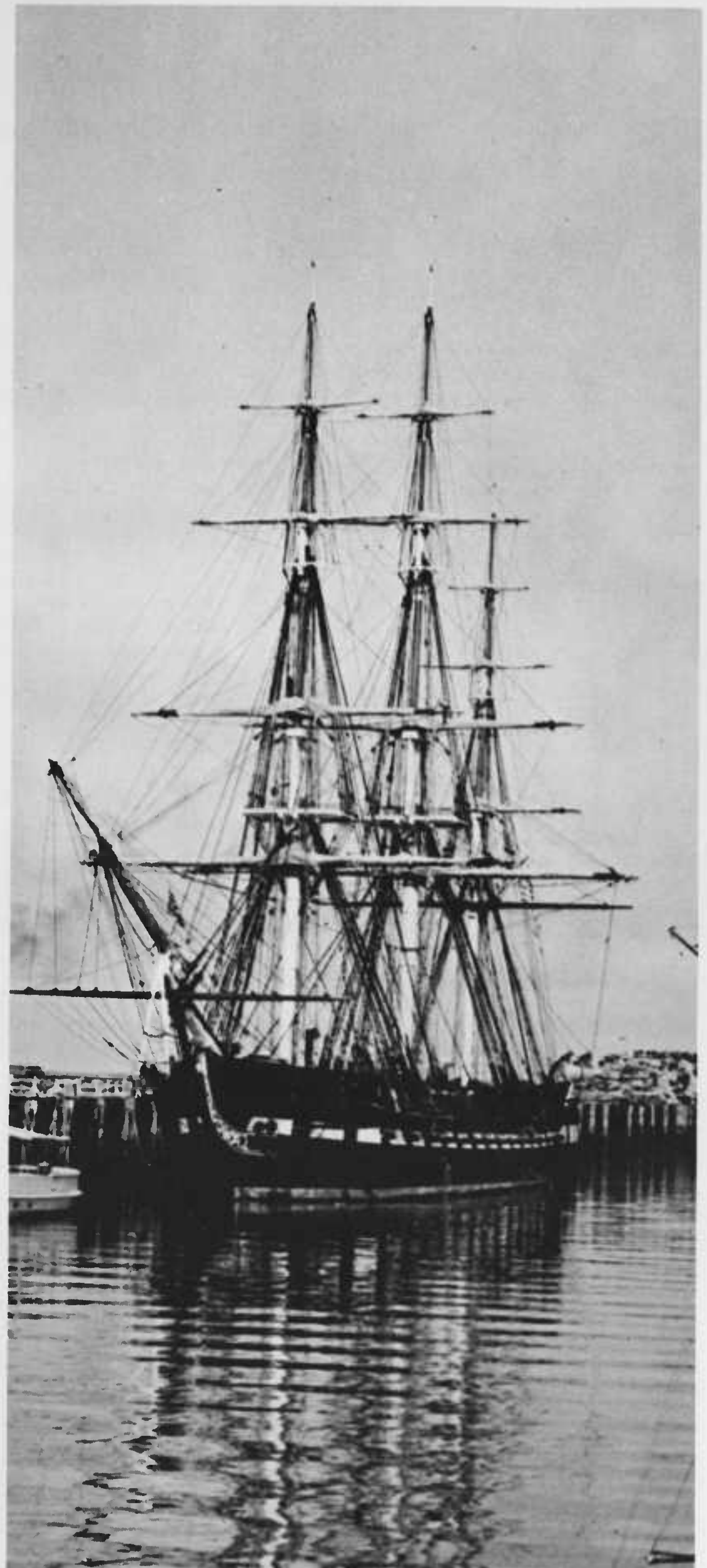
Despite all precautions, some water gets into every boat. Furthermore, if moist air is allowed to accumulate in the hull, some moisture may condense on cold wood surfaces, or on metal from which it can run onto wood.

Ventilation is absolutely necessary. Expose all wood surfaces to the air so far as possible. Paint, which slows the rate at which water enters, is undesirable on inner surfaces below decks because there it also slows down the escape of moisture from the wood. Painting unseasoned wood increases chances for fungal decay. Paint or varnish improve appearance and illumination, and make cleaning easier, but the

Double-planked areas are likely places to look for decay; faying surfaces, such as this rub rail's, make it doubly likely. Decay spread slowly from this seam. Use a wood preservative when installing new planking.

The condensation inside this cabin window means trapped moisture. Cabin ventilation needs attention; the steady flow of this condensed moisture to the side and bottom molding created a breeding ground for decay fungi.

Break a paint bubble—and you may find decay underneath. This bubble was a good indicator of invisible condensation, moisture that passed through the wood to the paint layer. Poor ventilation? Trapped water?



claims of protective value for paint have been greatly exaggerated. (Open boats are an exception and probably should be painted inside.)

Single planking is less subject to decay than double planking. Chain lockers and spaces next to the transom or around reefers deserve special attention, as do compartments where wet gear is stowed. Widely spaced auger holes are not sufficient ventilation for lockers and other enclosed spaces. Experts emphasize the need, even in small lockers, of ventilating openings through both top and bottom of each door.

Gratings in decks improve air circulation in the bilge, but if they allow dirt to accumulate beneath, they may indirectly favor decay.

Place ventilator openings from above deck at opposite corners of the larger hull compartments to eliminate dead air spaces below. For boats tied up for considerable periods or for compartments that prove especially difficult to ventilate, use blowers at outlet openings. Very rapid air movement is not necessary, but some movement *is*.

It really works—try it!

Wood boats built properly of good materials, and well cared for, may give good service for many decades. Indeed, some enthusiasts consider them more durable than steel boats. Decay cannot be entirely prevented —but it is also next to impossible to prevent steel from rusting!

Probably America's record for durability in a wooden vessel is held by the U.S.S. *Constitution*—"Old Ironsides." Launched in 1797, and after five major restorations (most recently for the U.S. Bicentennial), she still retains about five percent of her original wood—live oak, redcedar, and white pine.

It's true that "Old Ironsides" has received extraordinary care for most of her long career, but many owners of wood boats may well feel that this is just the kind of care their much smaller (and less well known) craft deserve.

The U.S.S. Constitution—"Old Ironsides" herself—rests in the harbor at Astoria, Oregon, May 1933. That year the Navy sent its oldest commissioned ship on a grand tour of the whole U.S. coastline. The voyage was made in the tow of the minesweeper Grebe. (Photo courtesy the Columbia River Maritime Museum, Astoria)

MV Ancient Mariner (christened the Seattle in 1913) is here moored to the oil dock in Ketchikan, Alaska, in 1967—with 60.6 metric tons of halibut aboard.

An example on the north Pacific coast is the MV *Ancient Mariner*, originally christened the *Seattle*. She was launched in 1913 and has been in service ever since January 1914. Most of her catch has been halibut, but she has also fished shark with gillnets, trolled for albacore, dredged for scallops, and pot-fished for black cod. Currently she is rigged for albacore.

A number of loads of lumber were rejected during *Ancient Mariner's* construction: high-mountain fir was finally chosen for most of her 27-meter hull, then cured before use.

A 1960 survey uncovered some decay in the stern timbers (the only trace in all those years) but judged her quite sound; a 1972 survey confirmed that judgment.

These two may be unusual cases, but they show what *can* be done.

Good materials . . .
the right kind of care . . .
these are what counted in the days of sail.
These are what count today.

Postscript:
Decay and the Bicentennial

Much of what we know about wood-boat decay was learned because of its grim effect on warships of past centuries. Detailed contemporary accounts describe the influence of decay in hulls and masts of the British Navy on two centuries of European history—and specifically on the American Revolution.

In the 1770's British warships were in such a serious state of decay that they could not be sent in sufficient numbers to repress the rebellion.

Then, and later against Napoleon, forced naval expansion resulted in hurried construction, use of poor timber (mostly sapwood, as the supply of durable white oak heartwood dwindled), and—inevitably—abnormal amounts of decay. Lord Nelson's dispatches bitterly complain about the difficulty of blockading continental ports with ships that had become too weakened by rot and other factors to withstand storm stresses.

The most striking case of damage from decay was to the 110-gun *Queen Charlotte*, a ship-of-the-line so long in construction that immediate replacements required upon completion cost more than the original construction. In contrast, such well-known ships as the British *Royal William* and the American *Bear* required relatively little repair work, even when very old.

An indication of contemporary "life expectancies" is the number of years during which insurance companies considered a ship a first-class risk. They assigned this classification for about 16 years to ships of the most durable woods (as teak and oak), 12 years to the commoner resistant species, and 6 years to the less resistant.

Another standard was "duration," used in the British Admiralty and apparently reckoned from the date launched until necessary annual repair costs for all causes totaled as much as a new ship. According to one writer, the average "duration" was 10 to 20 years for different periods of two centuries. (This practice did not necessarily mean that the ship was withdrawn from service when the "duration" was reached.)

Good materials . . . the right kind of care. . . . How would *your boat* rate when tested and compared with ships built a century ago?

METRIC EQUIVALENTS

To convert	*to*	*multiply by*
feet	meters	.3048
inches	millimeters	25.4
tons (2000-lb.)	metric tons	1.1023
degrees Fahrenheit	degrees Celsius (formerly Centigrade)	5/9, after subtracting 32

9-75/10M

15 x 2 = 30 ll 9/10 spare

OREGON STATE UNIVERSITY
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