ON ROTTING WOOD.[1]

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For some time I have been carrying on a series of experiments on the physical characters of American woods. Incidental to this work, some facts have impressed me so strongly that I think it well to bring them before this Association, even though the facts be not entirely new to science. The aim of the experiments is, a quantitative determination of the hygroscopic characters of certain woods, the amount of sap contained in green wood at different seasons of the year, the relative amount of soluble matter in green and in seasoned woods, etc.

It is well known that all woods contain nitrogenous compounds, known chemically under the general name of *albuminoids*, and that these substances are active in inducing decay. All chemical methods for the preservation of timber from rot look towards getting the *albuminoids* in some less soluble condition or some chemical combination less liable to decomposition. When green wood is well soaked in cold water, much of this albuminoid matter is dissolved out, and the solution is very putrescible, more so indeed than any person present would deem possible without having tried the experiment (and it is an experiment I would advise you to make). The fact is as true of the hardest woods, as maple and locust, as it is of soft woods like magnolia.

To illustrate: if a few pieces of such green wood, say of locust (which I cite because it is a hard and particularly durable species), be carefully freed from bark and all foreign dirt and put into pure cold water, even distilled water, and let stand at the ordinary temperature of our rooms (but better at 75° or 80° Fahr.), the water soon begins to become turbid and opalescent; this opalescence increases, in a few days, more or less according to the temperature, a pellicle forms on the surface, thin at first, but with some species it soon becomes thick and gelatinous, active putrefaction goes on, accompanied with an abundant growth of the septic ferments, and the liquid in due time becomes peculiarly and pungently stinking.

Without any visible evolution of gas, the liquid soon becomes very offensive to the smell, even when very diluted. The odor naturally varies with the species of wood used, but with most kinds I have tried, it is very rank, I think fully as much so as the same amount of *animal* matter would pro-

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duce. The intensity and rapidity of the putrescence varies, of course, with the temperature, the kind of wood, the degree of concentration of the solution, and with the amount of tannin and other extractive matters having antiseptic characters.

As in the case of other putrefactions, we do not know what the gases are which produce the smell; it is probable that they are organic compounds of simpler molecular constitution than the albuminoids; and it is also probable that, as in other odors, the absolute amount exhaled is very small in comparison with the result produced on the senses.

No chemical examination has been made of the ultimate products. If kept long enough and of sufficient concentration, there is an abundant fungoid growth in the solution. If kept in the light it usually grows darker in color, gradually becomes sour to the taste and the smell, but continues offensive in odor, I know not for how long, but in bottles partly filled and stoppered, in some cases it continues to smell badly for one or two years. Regarding the duration of the odor, the color of the solution, and the character of the liquid after the first few weeks, my experiments are very incomplete. Where the solution is kept in the dark, the odor seems more offensive than where the putrefaction goes on in the light; but in this direction also, my experiments are neither numerous nor complete.

In the free air and in full or partial sunlight (and this is the condition to which piles, and the vegetable matter in swamps are subjected), a white fungous growth takes place, on the surface of the wood, which becomes slimy as it increases. This growth is more abundant on the ends of the grain of the wood than on either the radial or tangential sides. If the solution is poured from the wood and kept in a separate vessel, the fungous growth continues, and the offensive smell goes on until the decay is complete; how long this may be I do not know.

If the wood be placed in successive portions of clean water, the soluble matter continues to be extracted for several months, even from small blocks, the tendency to putrefaction grows less and less, and finally ceases only when the total amount of water used in the successive washings has been enormous, compared with that of the wood. Finally, however, the soluble matter appears to be removed, the water then remains clear, and the wood ceases to be covered with the slimy fungus, at least to any considerable extent.

It has long been known that timber which has been thoroughly water-seasoned is very durable, and it is probable that this is solely because of the removal of the soluble and putrescible albuminoids.

Experiments tried with some of the same woods in sea water and in brackish water (made by mixing two measures of fresh with one of sea water) show similar results. The turbidity begins sooner in sea water than in fresh, the opalescence is denser, the film on the surface becomes thicker, and the smell is more disgusting, and sulphureted hydrogen is perceptible. One also recognizes the characteristic "blue mud" smell, so well known in many of our harbors and about our wharves. The number of experiments with salt water is, however, much less than with fresh water.

Heart-wood and sap-wood act essentially alike in this matter; the difference is one of degree rather than of character.

The suggestiveness of these experiments is too obvious to need much comment here, and yet I will add a word more. If piles about our wharves and similar structures in water do not smell so badly, it is merely because that the solution is so much more diluted. The decay, however, goes on just the same, or even more rapidly, for it is well known that dilution of albuminous substances hastens their decomposition. The vegetable matter decaying in swamps, where the relative amount of water is less, often shows the results more evidently. In the decay of sawdust and other vegetable matter under the still water of ponds, there is a more obvious evolution of gases, notably of light carbureted hydrogen; and because it is easier seen, and its presence proved by chemical analysis, malarial trouble has been attributed to it. But, as I stated in a paper read at a previous meeting of this Association, I do not believe that those permanent gases, nitrogen, carbonic acid, and light carbureted hydrogen are the really injurious exhalations from swamps; they are the most obvious ones, and hence they have been accused of the mischief. Whether the unwholesome effects of the exhalations from swamps, and decaying vegetables in water, are due mostly to the organic gases which accompany putridity, or in organisms which develop under these conditions, remains yet to be proved. I have proved that the solutions of wood produce septic ferment organisms in great abundance, even when the solution is very diluted, and each succeeding year brings more knowledge of an intimate connection between disease and the septic ferments, or organisms which belong to that class.

The exhalations of swamps and from vegetable matter decaying in still and shallow water are universally regarded as unwholesome to men of our race in climates as warm as ours is in summer. The experience of our race from the earliest ages, and in all parts of the world, has created this belief, and hence I deem it unnecessary to argue the sanitary bearings of the experiments I have described.

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