weather. After the halowax is dissolved, 200 grams of anhydrous lanolin is dissolved in the mixture. If hydrous lanolin is used, about 300 grams is required, since hydrous material contains approximately 35 per cent. of water. In case anhydrous lanolin can not be obtained and the hydrous material is used, after solution has taken place a layer of water mixture collects at the top, on standing. The lower layer should be separated by use of separatory funnel. After the halowax and lanolin are completely dissolved, 50 ml of cedarwood oil is added. This solution should be kept in a tightly stoppered bottle.

The solution may be applied to the book bindings as a spray, but we have found it preferable to use a camel's-hair brush. Care is taken that a uniform coating is applied to the book. The book is held or placed in open position until dry. The solvent mixture dries quickly, since the solvent components have a high vapor tension. When dry, if too much wax appears in places it may be smoothed by the brush dipped into the solvent.

Carbon tetrachloride and benzene can be obtained on the market cheaply and in pure form. A mixture of the two in equal volume forms a solution that is not explosive. However, reasonable precautions should be observed. This solvent, aside from being cheaper and easier to obtain, forms a more homogenous solution than does hexane. The halowax used has a higher melting point and gives a better polished surface than beeswax.

The lanolin gives the oil protection to the book bindings, especially in the case of leather bindings. The lanolin does not become rancid on standing. The quantities of halowax and lanolin may be varied, depending on the particular binding to be treated.

This treatment protects the book from the atmosphere, the halowax and lanolin forming a waterproof film after the solvent has evaporated. Any breaks in the film due to bending may be smoothed by brushing with the solution.

The halowax itself is an efficient repellent towards fungus diseases and towards insects and rodents. In case that further treatment with insecticides or fungicides is desired, these may be added to the solution (provided they are soluble in the solvent) and applied at the same time.

Book bindings so treated can be cleaned and washed without damage to the bindings. The coating produces no change in color and the dye does not "run" in the solution.

This formula was worked out at Dartmouth College with the advice of Professor C. E. Bolser. The formula was tested by the Baker Library of Dartmouth and proved very satisfactory.

Halowax may be obtained from Halowax Corporation, 247 Park Avenue, New York City, the cedarwood oil from any drug store and the other materials from any chemical supply house.

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SPECIAL ARTICLES

WOOD OPALIZATION

ABSENCE of petrified dicots in older Mesozoic sedimentaries, though many other forest types, either calcified or silicified, occur the world over from Paleozoic times down, even twenty-five years ago seemed primarily due to non-existence of the dicots. Then the antiquity of flowering types began to come into view; and presently Dr. Marie Stopes was able to describe four well-defined genera of dicot stems (partly calcified?) from the lower Greensand. Nextly, Kraeusel reported a further type from the weisser Jura of Germany. While a Trochodendron-like stem fully silicified from the mid-Jurassic of India has just been described by Sahni.

Valid reasons for a sparsity of dicot stems in many pre-Tertiary horizons are purely physio-chemic. In lignites, due to easy liability to bacterial decay, dicots are often found much broken down where conifers still retain their finer structures. In accord the beds of coal are made up of decay-resistant types. Also, chalcedonized logs, with coaly centers or surfaces, are often noted in the field; and since much partly lignitized, partly silicified material occurs, the suspicion is emphasized that in all probability, in fresh-water beds at least where change is slow as compared with what goes on in eruptives, it must be woods in the lignitic condition that are replaced by silica or calcium carbonate. The lignitic or lightly carbonized stage once passed, there is little further replacement, else there should be notable silicified bands in bituminous and anthracite coals, in the various forms of durain and vitrain. Such are quite unknown.

Evidently siliceous or calcareous replacement depends on what are termed "reversible" chemical reactions; and once log rafts reach the lignitic condition any abundance of lime with câlcitic deposition and some desiccation must be peculiarly favorable to a later course of opalization. Filling in of desiccated lignites by sheets of calcite was seen by Brown in one of his Pleistocene mammal quarries in Eastern

Cuba; and such a condition surely occurred in the early course of petrifaction in the superb Dresden cycadeoid Raumeria, being also indicated in stems of the Black Hills Como.

Calcification direct, however, seems precluded in eruptives or mainly ensues under delta or coastal marine influences and conditions, as in "coal balls," in the palms of the Pierre, and notably at the Wealden "log raft" of the Isle of Wight, or on the coast of Australia, as recorded by Mantell. In 1843 Hugh Miller saw the farmers of the Sutherlandshire coast at Helmsdale quarrying and burning (!) for lime the large annular ringed calcified logs of the Oölite. These are mainly conifer forests.

Apparently, where silicified dicots occur at all in fresh-water sedimentaries, their presence has been in some way favored by unusual conditions or influenced by nearness to epicontinental sea-levels or waters. The fossil forests of the Cairo region, known for a hundred years, may be cited; while the dicot forest with Lauraceous types which I found along the Chuska Mountain front of New Mexico may not be an exception. This is the finest older petrified dicot forest thus far found in North America.

Nevertheless, as noted in the Carnegie Institution Year Book for 1930, monosilicic acid thermal in source must account for certain petrified forests; and corollary to the slight decay resistance of dicots, their most typical occurrence is in eruptives, as seen along the slopes of the "Specimen Ridge" above the Lamar River in the Yellowstone Park. Much of the petrified dicot record must hence be lost, since the eruptives which would contain it are, as geologic time goes, most evanescent features; though it could be admitted —is in fact apparent—that, during the post-Jurassic course of both dicot and monocot stem evolution, decay resistance has been somewhat increased. Certainly the palms are freely petrified in sedimentaries after lower Cretaceous time. Albeit in later courses of volcanism, with the decay factors eliminated, and in the presence of both heat and abundant soluble alkaline silicates, the dicots reach as free silicification as conifers, and both are found in the more and more opaline condition. What may be the most recent examples of wood opalization can not have been very well reported, though Pleistocene woods freely occur; while so far as casual observation goes the pre-Miocene forests generally have lost their water content and reach solid chalcedonization.

Nearly all my own earlier field contacts were with the Mesozoic sedimentaries, and there the greater record seemed to lie. But once I became aware of the opalized dicot-conifer record it seemed amazing. It is in fact a record but superficially described. The opaline forests of the eruptives were long just examples of opal to the student of orogeny, indicating earlier thermal conditions and replacements; while in this country at least those botanically informed seldom studied first-hand the occurrences along the remoter mountain slopes. Dependence of opalization on the decay factor got as little attention as the rate of replacement and water loss in the several types of wood, surely a subject of sheer interest.

Time factors being thus undetermined, and observations such as those of replaced pine needles in the kettles about the Yellowstone Lake merely casual, attempts made in laboratories from time to time to mineralize wood have hardly reached dignity of record in chemical journals; while no great industries being dependent on the silicon series, it is still relatively unstudied. Impregnations or siliceous sinter coatings are the merest first stages in wood opalization. Nor would it be a practical scientific solution of the greater problem to stop short of analyses and complete replacements. The nature of siliceous gels, their solubilities, the fact that the action of the soluble alkaline silicates on cellulose is hastened by heat and probably by inequal pressure accelerating capillary flow through impregnating wood, has been evident enough. Long ago Church silicified corals in the laboratory. Nevertheless, the years have gone on without specimens of artificially silicified woods appearing in the laboratory. Such, when they do come, to be convincing should be brought at least to the clear opalization stage, and should have size enough to in some measure determine possible use in the arts.

The brilliant colorings of the opalized and chalcedonized woods of the lavas and ash are always a source of wonder, though long reproduced artificially by means of well-understood technique. But what must astonish much more from any chemico-physical point of view is the even light coloring of large silicified or opalized logs, indicating with dissolving out of the last traces of cellulose a reaction in an abundant and uncolored gel as steady and as well defined chemically as even the segregation of a quartz crystal or a sphere of hyalite. In a study to be brought out by the Field Museum of Chicago I have given what is trusted may prove a needed and readable general account of petrified forests, with adequate references to the literature concerned.

G. R. WIELAND

CARNEGIE INSTITUTION

ON THE BEHAVIOR OF A GLASS PLATE FLOATING NEAR THE EDGE OF A FLAT-TOPPED DROP OF MERCURY

IT does not seem to have been noticed that while a thick plate of glass floated on the top of a flat drop of mercury is thrown off by the capillary forces, if it