

damage involves 12 to 15 per cent of the best part of every merchantable tree.

"It is estimated that 5 per cent of the forest, yielding or being worked for naval stores under the old box system of turpentine, is either dead or thrown down as a direct result of the severe cutting necessitated by this method. This amount may be safely reckoned as a total loss, since the scattered and isolated occurrence of areas so affected are not usually reached by lumbering operations before the timber is badly affected by decay and wood-boring insects.

"The remaining 12½ per cent of forest yielding naval stores is being worked under an improved system of turpentine known as the 'cup and gutter' or 'cup and apron' method. No deep box is cut at the base of the trunk and the turpentine pine trunks are injured only as a result of the season's chipping, which is on the whole as severe as that resorted to under the box system. The timber is, however, not in danger of being thrown by storm, because the trees are not weakened by a deep box at their bases. This type of timber is relatively in thriffter condition than that worked under the box system, because it has received less injury. It is, moreover, as a rule, unburned, for the reason that the intrinsic value of the cup and gutter outfit (liable to destruction by fire) compels greater protection against fire than is usually provided in the case of boxed timber.

Physical Effects of Different Methods of Turpentine in the Past Upon the Life of the Forest.

"Timber worked for naval stores under the old box system is more subject (1) to fire, from which may result death, or such injury of vitality that little or no product is yielded afterward. From the severity of the box cutting large areas may be thrown by wind and be wholly lost; (2) under this system the forest is rendered unproductive of naval stores practically after the fourth year. Three to four years more of production may be added by cutting boxes on unused sides of the trunks ('back boxing'). The more enlightened operators who own, and, therefore, value and expect to utilize their forest for lumber after the first four years' use, refrain from 'back boxing' to avoid the certainty of total or very great loss likely to follow from windstorms, which, as already shown, such overboxed timber is too weak to withstand.

All Young, as Well as Old, Trees Are Turpented.

"In the earlier great abundance of naval stores producing pine timber only large trees were boxed. The young pine trees were left to grow. 'Worked-out' timber was then quickly abandoned for new crops of round timber everywhere abundant.

"The enormously depleted supply of round timber of to-day results in the boxing of practically every tree the land carries, down to four or five inches in diameter. This, too, frequently includes every tree. (Profitable returns cannot be expected from timber less than ten inches in diameter.) No young, unimpaired trees remain to form the future forest. The controlling purpose of this short-sighted policy is to strip the land as completely as possible, because in the life of the present operator another crop of naval stores is not expected. Young trees so severely boxed cannot recover sufficiently to grow into thrifty, sound timber; they usually die. Possibility of profitable naval stores production in all sections so treated is

either wiped out or will be within half a decade.

New Cup and Gutter System.

"Timber worked for naval stores under the cup and gutter system, more conservative than the old box method, is:

"1. Least subject to destructive fire, even when the usual annual 'raking' is omitted. There are no deep boxes containing greater or less quantities of highly inflammable resin close to the ground, which, once fired, makes possible a burrowing fire at the base of the trees.

"2. The trees are not weakened by a deeply cut box, and hence not liable to be wind-thrown. With only a minimum injury from chipping trees worked under the cup and gutter system maintain vigorous vitality during the period of production, while afterward the trees continue to grow thriftily. Even very small trees so worked survive the strain and continue to grow rapidly afterward.

"On the whole, pine forests 'worked out' in part or completely under the cup and gutter system have undergone much less injury as regards their growing vitality than would have been the case had they been boxed. Ripe timber is in condition to be lumbered without loss by storm, while the young trees are still in thrifty condition.

Loss of Possible Product under Ancient Box System.

"Naval stores production under the ancient system of boxing the tree is carried on at a loss of from 20 to 30 per cent of the possible total product. Moreover, the highest grade of rosin is produced by this method only during the first season.

"The total loss of product (extending over the four or five years of exploitation) is due (1) to undue evaporation (avoidable under a conservative method) of turpentine by long exposure of the crude resin, which must run farther and farther each season over the chipped face of the trees before reaching the box. At the end of the first season the distance traversed by the resin is approximately fifteen inches; second season, thirty inches; third season, forty-five inches; fourth season, sixty inches. Evaporation is relatively greater each succeeding season, as the resin is exposed to the air for a longer time each succeeding year.

"The total loss in the quality of the product is measurable only in the grades of commercial rosin produced. Resin gathered from first year or 'virgin' boxes yields the highest (whitest) grade of rosin. That gathered from second, third and fourth year boxes yields lower and lower (darker colored) grades of rosin which sell for lesser prices than the highest grade.

Increased Production Under New Cup and Gutter System.

"The total loss of from 20 to 30 per cent of turpentine under the ancient box system of turpentine is saved by use of the new cup and gutter system. This saving is made possible:

"1. By preventing the long exposure to the air of the dripping resin, which each succeeding season traverses uniformly not more than fifteen inches of the tree's chipped face before entering a circular, impervious clay or metal receptacle. The distance traversed by the resin, and hence its exposure to the air, is rendered uniform each year by moving the metal gutters (which catch and direct the resin into the receptacle) up to the cup at the end of every season.

"Measurable gains in favor of this system also are the facts that less evaporation

of spirits occurs from the smaller surface of resin exposed in the circular cup than from the larger surface of resin exposed in the box, and greater economy of crude resin is possible also in gathering ('dipping') resin from circular, smooth cups than from the rough boxes. Much resin is wasted in dipping from boxes, as well as in being imperfectly directed and caught in the boxes, while no resin is wasted when it is being directed into the cups or in collecting from cups. Practically all of the resin yielded by cupped trees is caught.

"2. The loss in the quality of rosin made from resin of boxed trees is prevented in the case of cupped trees by causing the resin to run uniformly each season only a short distance into the receptacle. A longer exposure of the resin is found to account for the dark color of inferior rosins obtained from two-three and four-year boxed trees.

How Long Naval Stores Production Will Continue Under Present Methods.

"It is estimated that naval stores production would continue, under present methods of exploitation, for twenty-five to thirty years. At that time it is certain that from an industry of the first importance in the South it would sink to an inferior position. This conclusion may be safely founded upon the history of the production in Virginia, North Carolina, South Carolina and Georgia (now practically worked out.) These States, once heavy producers, have retired from the field of important production, not to enter it again under present methods of exploitation. The States now yielding naval stores are necessarily meeting a much more intensive demand both for naval stores and for lumber (which must, in succession, come from the same forest) than forests of the exhausted States could possibly have been subjected to. It is even probable that present-day methods of exploiting naval stores forests would bring the end in less than twenty-five years.

Attitude of Naval Stores Operators Toward Permanency of Industry.

"Present day naval stores operators appear generally content to believe that continuance of their industry is coincident with the endurance of Southern pine forests. The conviction is fixed that a given forest can be worked only four years, when new (round) timber must be sought for a continuance of operations. The end of this production is clearly conceived to be coincident with that of the virgin forest.

"The idea of placing this industry upon a stable, permanent foundation by adopting a more conservative method of operating appears to have been but little thought of. To this end, the idea of adopting the cup and gutter system, a method of exploitation more conservative of the forest's life, in order that operations might not, as under the ancient method, destroy the trees, proved to be a most difficult undertaking for the Forest Service to propagate among operators, so fixed had become the belief that no method except the ancient one could be profitably employed. The accomplishment by the Forest Service, through four years of incontestable demonstrative field results, of showing that the cup and gutter system should replace the old box method, was achieved against the deepest sort of prejudice and disinclination among otherwise intelligent operators to accept a new system for the one inherited so long ago. The argument had to be abandoned that, if the new system insured as great a return in naval stores as the old destructive method, it would be to the in-

terest of timber-owning operators to apply this new, conservative method because, not necessitating the cutting of a deep basal box, it injures the tree far less than the ancient system. The idea alone of conserving the life of the forest, of leaving it in as thrifty a condition as possible after naval stores production, found little or no support. Had it not been possible for the service to show by actual figures of yield that the new system gives a return of from \$1,500 to \$1,600 per 'crop' (10,000 trees) in place of about \$1,000, the old method would still be in universal use, where now some 30,000,000 cup and gutter 'crops,' one-half of the total operations of the country, are being worked.

"Even with this overwhelming proof of what the new conservative method offers in money returns alone, there are many intelligent operators who will not abandon the old system. There is probably not another example to be found in the development of industry in this country where regional prejudice is so strong against a change of old customs. It is believed, however, that ultimately the idea of maintaining highest conservation in naval stores production and of placing this industry on a permanent basis can be made to prevail.

"Economic conditions are such in the United States that the extremely conservative system of production prevailing in European countries cannot be adopted here. The returns accepted there from a naval stores forest are too small to attract the average American operator. The rate of production and the profit are comparatively much larger here and must needs continue to be in order to satisfy our social conditions. Our past lavish waste in producing naval stores must be reduced to the strictest economy in method of exploitation and in perpetuating, by full use, the life of naval stores producing forests.

What Is Accomplished in Conservative Naval Stores Production and in Lengthening the Life of the Forest by a New Method.

The Forest Service has established by incontestable experiments that the cup and gutter system of deriving naval stores:

"1. Yields 30 per cent more product than the ancient method.

"2. Does not so weaken the trees physically that they are in danger of being wind thrown.

"3. Leaves the timber in thriffter condition because it has not been severely injured by box cutting.

"The advantages accruing directly to timber-owning operators are much greater returns in money (approximately 50 per cent more than from the old system), and insurance of the timber against destruction by storm before it can be lumbered. The fact that boxing leaves the timber in imminent danger of total destruction by storm has prevented not a few pine timber owners from turpentine their forests at all. Such loss of profit to those people for want of a safe system of exploitation can now be obviated by adopting, if not the system shown to be most conservative, the cup and gutter system, even with the old method of deep chipping, in place of the destructive box method.

What May Be Expected from Still More Improved Methods of Producing Naval Stores.

"A still more conservative method has been discovered by the Forest Service, and its absolute practicability has been thoroughly established by experiments during