

HAWAII AGRICULTURAL EXPERIMENT STATION.

J. G. SMITH, SPECIAL AGENT IN CHARGE.

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BULLETIN No. 11.

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THE BLACK WATTLE  
(*Acacia decurrens*)  
IN HAWAII.

BY

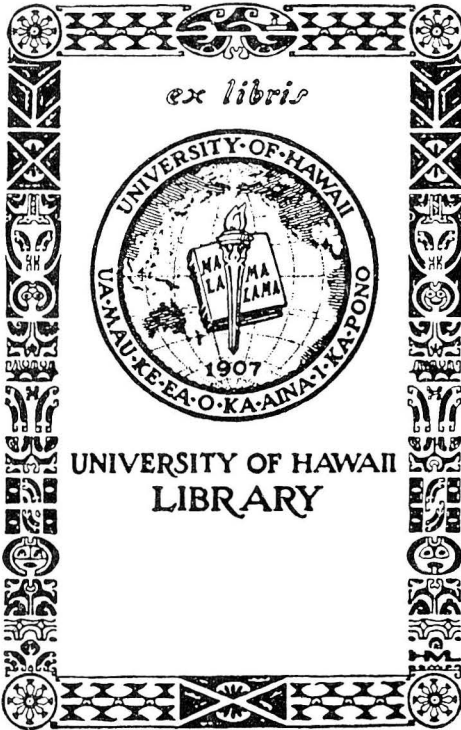
JARED G. SMITH,  
SPECIAL AGENT IN CHARGE,  
HAWAII AGRICULTURAL EXPERIMENT STATION.

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UNDER THE SUPERVISION OF  
OFFICE OF EXPERIMENT STATIONS,  
*U. S. Department of Agriculture.*

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WASHINGTON:  
GOVERNMENT PRINTING OFFICE.  
1906.



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**HAWAII AGRICULTURAL EXPERIMENT STATION, HONOLULU.**

[Under the supervision of A. C. TRUE, Director of the Office of Experiment Stations, United States Department of Agriculture.]

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## LETTER OF TRANSMITTAL

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HONOLULU, HAWAII, *January 1, 1906.*

SIR: I have the honor to transmit herewith a paper on The Black Wattle in Hawaii and recommend the same for publication as Bulletin No. 11 of the Hawaii Agricultural Experiment Station.

Very respectfully,

JARED G. SMITH,  
*Special Agent in Charge,*  
*Hawaii Agricultural Experiment Station.*

Dr. A. C. TRUE,  
*Director, Office of Experiment Stations,*  
*U. S. Department of Agriculture, Washington, D. C.*

Recommended for publication.

A. C. TRUE,  
*Director.*

Publication authorized.

JAMES WILSON,  
*Secretary of Agriculture.*

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# THE BLACK WATTLE IN HAWAII.

## INTRODUCTION.

The Australian black wattle (*Acacia decurrens*) has been in cultivation in Hawaii for about forty years, trees of about that age existing in the Hamakua and Kohala districts on Hawaii. This leguminous tree reaches its fullest development in these islands. It grows on a variety of soils, but thrives best on rather heavy soils at an elevation of from 800 to 3,000 feet above sea level, in districts where the rainfall ranges from 80 to 150 inches per annum.

In January, 1905, the Hawaii Experiment Station commenced to harvest the tan bark from a 6-acre grove of black wattle situated at the lower edge of the Tantalus forest. The trees were growing on a very steep slope at an elevation of from 600 to 800 feet above sea level. The grove had been planted about thirteen years. In addition to about two tons of bark, which was shipped to various tanneries in the United States for experimental use and for which no charge was made, 36 tons of bark were sold, realizing \$839.44. Besides the tan bark, 500 fence posts and 88 cords of firewood were obtained. The firewood was sold for \$689.25, so that the total value of this grove of black wattles amounted to over \$1,600. The total yield per acre was valued at \$254.84, of which \$139.97 was for tan bark and \$114.87 for firewood. The wood averaged \$7.83 per cord and the bark \$23.31 per ton.

During the period from 1888 to 1893 there was a great deal of interest taken in wattle planting in Hawaii. At that time there was a shortage of European tanning materials, which resulted in a good deal of activity tending toward the substitution of new tanning materials for the valonia oak. Tan bark doubled or trebled in price and many persons not only here in Hawaii but in Australia and South Africa looked upon wattle growing as a very promising method of quickly achieving large profits. A considerable amount of seed was secured and distributed throughout the islands, so that now there is hardly a district where full-grown specimens of this tree can not be found. Although forest planting was advocated, apparently the only forest planted was that on the Tantalus ridge. The occurrences of

1893 and subsequent years diverted public attention entirely from the development of this and other minor industries to the more immediately profitable sugar industry, and no extensive planting of this tree was made.

During the twelve years from 1893 to 1905, the trees in the Tantalus forest had reached their full development. During the four years that this station has had possession of this portion of the forest about 20 per cent of the wattle trees died from various causes, not only because many of the trees had reached their limit of growth, but on account of injury from stock and by insects. It was therefore deemed advisable to harvest the trees and endeavor to make as much out of them commercially as possible, in order to demonstrate something of what might be obtained in the way of returns, provided this tree were to be planted on a commercial scale.

Almost everybody in Hawaii is fully convinced that it would be well from the æsthetic point of view as well as the practical to extend the area of forests. The value of forests is well recognized for water conservation and to a greater or less extent as a source of firewood. However, little thought has thus far been given to planting trees which will not only make a forest cover but will yield a good investment on the money spent for planting the trees and for caring for them during the early years, when they require more or less care.

It is believed that by planting tan-bark trees, especially the black wattle, the cash values obtainable at the end of a given period will yield a large return of profit. It is furthermore believed that trees or plants yielding tannin will supply a product of increasing rather than decreasing value. The natural resources of tannin are becoming depleted in Europe and the United States.

It is a matter of interest that at no time during the last fifteen years has the price of wattle bark fallen to less than \$20 per ton. The average price in Natal, which country produces the bulk of the world's cultivated supply, has ranged from \$29 to \$35 per ton during the last five years.

#### CULTIVATION.

If the land to be devoted to wattle cultivation is level or reasonably so, it would be best to plow it. Of course gulch and mountain land or broken slopes are not capable of being plowed. If the land is plowed, it should be allowed to rest for three to six months, and should then be harrowed and cross-plowed. One pound of good seed will plant 10 acres.

The seed is covered with a very hard skin, and when placed in the ground without previous treatment germinates slowly. Two methods of improving the germination of the seed are in vogue. The safer method is to put the seed in a bucket and pour boiling water upon it



and allow it to stand for twenty-four hours. The other method is to scorch the seed in hot ashes by building a fire, allowing the wood to burn until there is a bed of coals, then rake off the coals and mix the seed with the ashes beneath. This latter method requires some judgment, as the seed should not be parched, but only scorched.

It is more economical to plant the seed in the place where the tree is to remain than to plant in nursery rows and transplant. The seed should be sown in rows 10 feet apart and 2 or 3 feet apart in the row. If the ground has been plowed, the young seedlings should be cultivated, and this can best be done by planting some secondary crop, such as corn, potatoes, cotton, or tobacco, between the rows during the first two years. Where two or three seedlings come up in one place they should be thinned, leaving only one plant about every 6 feet. If gulch lands are chosen for planting, holes 3 feet in diameter should be dug at intervals of 6 by 10 feet, and the holes should be filled up with top soil mixed with weeds or grass and the seed planted in the holes thus formed.

A forest which is given the benefit of two or three years of cultivation, as would be the case if an intermediate crop were grown between the rows, will make far better and more rapid growth than trees simply set out on uncultivated land. The value of the intermediate crop would also offset the cost of planting the forest. After the third year the trees will be large enough to take care of themselves, and, if planted close, will so shade the land that weeds and grasses can not grow. The chief enemy of a forest of this character is fire. On that account it is better, if a large acreage is set out, to plan fire lanes or avenues between the forest blocks, so that the soil in these fire lines may be plowed and kept bare of weeds and grasses. If the acreage is sufficiently large to warrant it, practically all the operations of sowing the seed and cultivating the land may be done with horses. One man with a good team and riding plows and cultivators ought to be able to take care of 250 acres of trees per working year of three hundred days; that is, plow the land, sow the seed, and cultivate the seedling trees. However, if an intermediate crop is grown between the rows during the first three years the amount of land one man can cultivate will be somewhat less.

#### HARVESTING.

The trees should be ready to cut in about ten years, the period of maturity varying with the character of the soil and the amount of rainfall. Trees of equal age in the Tantalus forest varied from 18 inches at the butt when growing on rich soil with heavy rainfall to only 6 inches in diameter on rocky, thin soil at a lower and drier elevation. Trees 10 years old, if properly grown, should yield at least 100 pounds of green bark, equal to 50 pounds of dried bark. Trees which have

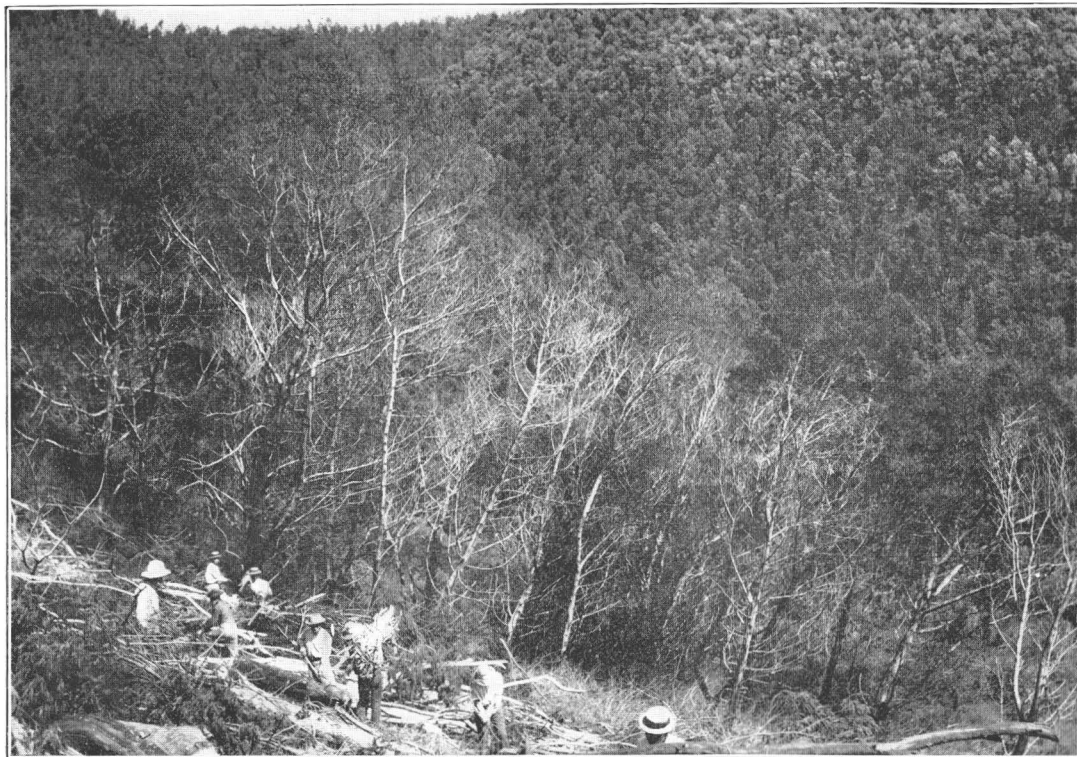
grown in especially good soil or under exceptionally good conditions even yield as high as 200 pounds of green bark, while those from drier and more sterile soil yield so little that it hardly pays to strip the bark. Hence it is the opinion of the author that while this tree is said to be one of those suited for even the most sterile soils, yet it is doubtful whether the black wattle can be profitably cultivated except on land of fairly good character. (Pl. I.)

Harvesting consists in cutting down the trees and stripping off the bark. (Pl. II.) In Natal, where this tree is cultivated on a very large scale, most of the bark is stripped from the tree while it is still standing. The laborer makes a cut as near the ground as he can, pries up a loose end of bark, and then jerks it loose from the tree, removing in this way a strip perhaps 6 inches wide and from 10 to 30 feet long. After the laborer has stripped all the bark that he can in this way the tree is cut down and the remainder of the bark secured. It is yet to be determined in Hawaii which is the more profitable method of harvesting the bark—whether it is better to cut down the tree and take the bark off after it is felled or whether it should be stripped from the standing trunk. The bark does not strip well in dry weather, but requires closer attention to prevent it from molding in wet weather.

During the drying process the bark must be carefully protected from rain. This is fully as important a point as the selection of good soil or care in cultivation, because bark which has been allowed to get wet after it is taken from the tree becomes of only secondary value. For the purpose of drying the bark large sheds or barns should be erected at some convenient location, such as the lowest point of the land, provided it is near to roads. In South Africa the drying sheds are rather small. The bark is hung up on poles, the ends of which fasten in rings on long chains suspended from a scaffolding. When fully extended this arrangement of chains and poles might be compared with a large rope ladder. During clear weather the contrivance is extended full length out of doors. When rain threatens, the whole arrangement of poles and chains is drawn back under the shed, shutting up like the folds of a bellows. (See Pl. III.)

There is considerable difference of opinion in regard to what makes bark of a good quality—that is, whether that which is dried in the sunlight or in the shade is of the better quality. It has been found in Hawaii that bark dried under roofs and not exposed to the sunlight at any time during the drying process was of the best color and brought the highest price. The main point is to dry it in such a manner that it will not mold. A high temperature should also be avoided.

A number of experiments have been made to determine the best and most convenient way of getting the bark out of the woods. If the drying shed is at the lowest point of the forest the bark can be bun-



STRIPPING TAN BARK FROM BLACK WATTLE TREES, HAWAII EXPERIMENT STATION.



BLACK WATTLE TREES GROWING ON STERILE, ROCKY SOIL, HAWAII EXPERIMENT STATION.

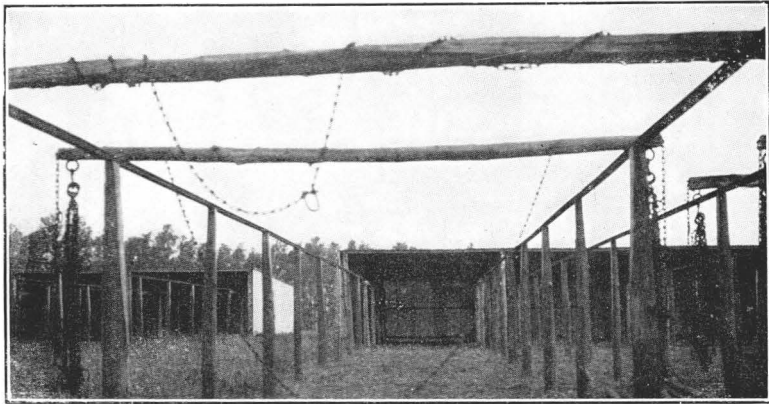


FIG. 1.—THE DRYING SHED, WITH ITS RUNWAYS FOR THE POLES.

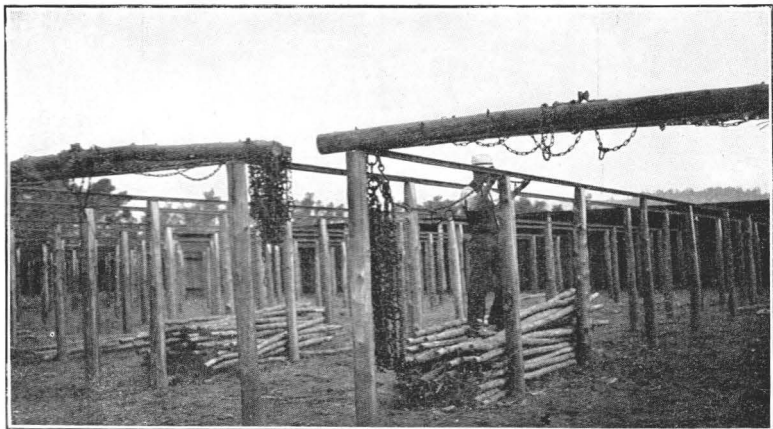


FIG. 2.—THE RUNWAYS, WITH THEIR CHAINS AND POLES.

A NATAL DRYING SHED.

Photographs by Mr. David Fairchild, agricultural explorer, U. S. Department of Agriculture.

dled and sent down to the drying sheds on wire trolleys; or if there is a sufficiently large acreage to make it worth while a portable track can be laid through the lanes and fire lines between the forest blocks and the bark loaded upon cars and sent down to the drying sheds under some sort of a gravity system. Where the bark is dried in strips, either hung from poles on the rings of a ladder-like contrivance or on wires or poles underneath a galvanized-iron roof, it has been found that a good deal of labor is required that might be done away with provided drying sheds of a little more expensive nature were constructed. The bark is cut a good deal easier when green than when it is dried. Green bark even from the butts of large trees can be cut with an ordinary feed cutter worked by a gasoline engine of low horsepower. The dried bark, on the contrary, requires special bark-cutting machinery. In the author's opinion, it would pay to build a large drying house, carrying the structure up from 30 to 50 feet and providing permanent scaffolding to carry temporary floors constructed of expanded or perforated metal or of slats placed 1 inch apart, the floors not over 18 inches apart. As fast as the green bark is received at the drying house it could be run through power cutters, chopped into lengths of 2 or 3 inches, and distributed uniformly over the perforated floors, beginning at the bottom of the house. A layer of chopped bark 3 to 6 inches deep will dry without molding, provided there is a water-tight roof over the building and good ventilation supplied. Artificial ventilation with low heat could be provided for drying the bark during the periods of rainy weather, while on clear days the ventilators and sides of the building could be opened up, allowing free access of air.

As labor is the expensive item in all agricultural operations, it will pay to put in a good plant wherever the area of forest amounts to over 1,000 acres. When the cut bark is thoroughly dried it can be compressed into bales of two or three hundred pounds weight, covered with burlap, and in that shape can be shipped or transported to any distance. If a plant is to be erected for working the wood as well as the bark, the woodworking and tan-bark drying establishments should be combined.

#### INFLUENCE OF CLIMATE ON TANNIN CONTENT.

Little is known in regard to the influence of climate upon the production of tannin, although it is usually assumed that plants grown in an arid or semiarid region contain more tannin than those grown where there is an abundant rainfall. Analyses of koa bark (*Acacia koa*) from trees above Hilo showed 17 per cent of tannin, while samples taken from trees growing on the mountains above Hoopuloa, in Kona, a much drier district, showed only 12 per cent. It is quite probable that the presence of large amounts of tannin in the roots,

bark, leaves, or other parts of plants is an inherent characteristic due to the species and not to the climate. Samples of wattle bark taken from trees growing in very wet districts in Hawaii show fully as high tannin content as the bark of trees growing in the very dry districts. A series of analyses made by the chemist of this station showed a range of from 25 to 36 per cent of tannin present. Furthermore, there was no apparent relation between the tannin content and the soil or season. It is therefore safe to say that the highest yield of tannin per acre can be secured from lands on which the trees during their normal growth will produce the largest amount of bark, and, presumably, the largest amount of bark will be produced on trees growing where the soil is good and the rainfall sufficiently heavy so that the tree will make an uninterrupted growth. The larger the tree the more bark, the more bark the more tannin, and, commercially, the higher the value.

Wattle bark is one of the principal agricultural exports from the British colony of Natal, in South Africa. About 12,000 tons, valued at an average price of from \$30 to \$34 per ton, are exported each year. The larger portion of this bark is shipped to England, but a portion is marketed in Italy. Its value in Europe averages about \$45 per ton, so that ocean freights, commissions, and selling charges constitute about one-third the value of the bark when it reaches the European market.

#### **TAN-BARK EXTRACTS.**

Besides the amount of bark shipped, a considerable quantity is converted into extract, and in this form some of it reaches the American market. Tannin extract is a concentrated diffusion of the green or dried tan bark in water. If green bark is used, the bark and twigs and even the younger branches of the tree are finely macerated, extracted with water by the diffusion process, and the extract boiled down in copper vacuum pans at low heat, filtered, bleached, and purified. When the extract has been concentrated to about the consistency of thick tar it is run into casks and is then ready for marketing. Liquid extracts contain as low as 20 per cent of tannin and as high as 50 per cent, while the solid extracts contain from 50 to 70 per cent of tannin. The price per pound on the American market varies with the tannin content and nature of the material from 1½ to 6 cents. All vessels used in connection with the extraction of tannin from the bark must be of copper, heavily galvanized iron, or zinc, as the tannin is quickly precipitated if it comes in contact with iron or steel. Tanners prefer to work with extracts rather than with crude barks, unless they have large plants capable of treating bark in quantity, or unless there is an abundant supply of cheap bark or other source of tannin easily accessible. If the cultivation of wattles is

undertaken on a large scale it will undoubtedly prove most profitable to make tan-bark extracts rather than to ship the much more bulky untreated bark to the market. When dried bark is used for making extract the yield of tannin is usually less than where fresh material is used. When extract is made from the fresh material the solutions contain a large amount of mucilage and gums which are difficult to get rid of.

### TANNING PROCESSES.

Hardly any two tanners use exactly the same solutions or methods in the manufacture of leather, but there is a certain resemblance in all processes. Up to 1880 the tanning process was simply to divest the green hide of its hair and adhering flesh and then soak it in vats containing tanning extracts of high concentration. The tanning process under this simple treatment often lasted several years. In 1892 discoveries were made by Fratri Durio of a process by means of which he was able to thoroughly tan hides in a few months instead of as many years. This process, although epoch making in that it created new methods of tanning, was not itself a commercial success; but Durio's discovery gave an impetus to experiments with chemical reagents and the use of the chemical treatment of hides. Improvement in method has been rapid, so that to-day finished leather may be turned out in twenty-five days from the time the hides enter the tannery. The Durio tanning process in brief is as follows: The dried or salted hides are usually soaked for twenty-four hours in warm water. When soft they are placed in a vat with limewater, sharpened with sodium sulphite or soda ash. The liming takes about six days; the hides are then unhaired and worked out and are rinsed in an abundant supply of cold water. The unhairing and fleshing process takes about one day. Fifty or more hides are then put in a slat cage floating in a large vat containing a dilute solution of lactic acid. The cage is agitated occasionally. This is to neutralize the lime in the hide. The deliming process consumes six to eight hours. The hides are then "handled" for nine or ten days, passing through a number of vats filled with 3 to 4 per cent tannin solutions, which have been allowed to ferment until they contain about  $1\frac{1}{4}$  per cent of acetic acid. When taken from the handlers the hides are allowed to drain and then are put in slat drums and half immersed in a 25 per cent tannin liquor. The drums are revolved slowly through the tan vats for from thirty-six to forty hours. The hides are then finished off by being allowed to hang twenty-four hours in a very strong tannin liquor. The sides are then oiled, dried, and rolled for the market. These final operations take four or five days.

The principle of tanning is to soak the hides to make them soft and then remove the flesh, hair, and fat with lime. The immersion of



from eight to ten days in a very weak acid tanning solution soaks the hide so that every fiber becomes swollen and the whole structure of the skin permeable, permitting the more concentrated fixing solutions containing high percentages of tannin to enter into every pore. The object is to swell the skin so that the finished side of leather will be two or three times as thick as it was before being tanned. This swelling of the hide is called "plumping." The final treatment in very strong liquor is intended to weight the hide and fix the fibers which have been thus abnormally swollen. As leather is sold by weight, tanners endeavor to add as much filler as possible without impairing the impermeability and wearing qualities of the leather.

Tanning extracts derived from the wattles and other species of acacias make a very durable quality of leather. Thousands of tons of acacia bark and acacia extracts were imported into Japan during the recent war for the purpose of manufacturing shoes and harness for the army. It is probable that the demand for acacia tan barks will continue and will increase rather than decrease, owing to the superiority of vegetable tannins over purely chemical reagents used for the manufacture of leather. Chrome leathers and other chemically tanned leathers lack durability and will not stand as much wear and tear as hides manufactured into leather by means of organic tannins.

#### WHAT TO DO WITH THE WOOD.

If the wattle forest is adjacent to a city or a large plantation the wood will find a ready market for domestic purposes. Black wattle wood burns with a clear flame. It is hard and tough, comparable with algeroba in fuel value, but somewhat more difficult to split.

If the forest is not adjacent to a plantation or other market the value of the trees for firewood will be much less. A limited amount can undoubtedly be used for tool handles, axletrees, spokes, etc., but the wood checks in drying so that it will probably find only local use for this purpose.

In this connection it may be well to consider the utilization of the wood in making wood alcohol. Many practical foresters have advocated making forest plantings on a large scale with a view to distilling the product, rather than utilizing it for lumber or other economic purposes, and a claim has been made that large areas of land could be profitably planted to forest trees with this sole end in view.

In the case of the cultivation of the black wattle for its bark alone the wood becomes a by-product, the cost of the production of which may be charged against the cost of the bark.

Assuming that 20 cords of wood can be obtained per acre, at the end of ten years 200 acres of land planted to black wattle would yield 500,000 cubic feet. By distillation 500,000 cubic feet of wood would yield as a minimum 1,650 tons of charcoal, 15,000 gallons of wood

spirit, 380 tons of acetate of lime, and a large amount of wood tar or creosote. Valuing the charcoal at \$11 per ton, the wood spirit at 60 cents per gallon, the acetate of lime at \$40 per ton, and the creosote at a nominal figure, the total valuation of the distillation products derived from the wood grown on 200 acres would be about \$44,000. These figures are taken from actual balance sheets of wood-distillation plants in the United States and Europe.

The one material point of difference between the cost of wood distillation in Hawaii and in other parts of the world would be the difference in the cost of fuel. Counting coal at \$3.50 per ton and allowing for interest on investment, depreciation and wear and tear of plant and buildings, the total cost of production should not exceed \$20,000, leaving a net profit of about \$24,000, or an average of \$120 per acre. The weak point in this calculation is the difficulty of finding a market for the charcoal, and also that coal or its equivalent, crude oil, is not at present landed in Hawaii at less than \$5.60 per ton, present fuel-delivery contracts having been made when cost of oil and ocean freights were nearly 100 per cent above present rates and prices. If crude oil can be delivered in Hawaii at 90 cents per barrel, it will be an equivalent of coal at \$3.60 per ton, approximately the fuel unit of value used in making the above calculations.

The value of wood for distillation purposes has been absolutely neglected in these islands. Thousands of acres of land covered with ohia forests, yielding at the rate of from 30 to 50 cords of timber per acre, have been pulled or cut down and burned simply to get them off the land. Cheap fuel oil can be landed in Hawaii at a cost not greatly above that of coal at the European price of \$3.50 per ton. By the utilization of the wood which otherwise might be considered only a waste product, it is believed that the whole expense of plowing, planting, cultivation, harvesting, and marketing of tan bark produced in a wattle plantation will be covered, so that by proper attention to details the total amount of tan bark which the trees are capable of yielding will represent the net profit on the investment.

One thousand acres planted in black wattle should yield \$150,000 worth of tan bark at the end of ten years. According to a recent report, there are upward of 4,500 acres of black-wattle plantations in New Zealand and upward of 60,000 acres in Natal. In New Zealand there is no good market for the wood, and no attempt is made to utilize it commercially. In Natal the wood is commercially more valuable than the bark, being largely utilized in timbering mines, a purpose for which its strength and durability make it exceptionally valuable. Some of the New Zealand plantations have reported net profits of \$80 per acre from the tan bark alone, placing sales of wood at nominal value over against the interest on the investment and taxes. Some of the South African wattle plantations have yielded

as high as \$500 per acre, gross returns, from the sale of tan bark and wood, but in this case the timber value averages 50 cents per tree. In Hawaii a black-wattle forest can be carried through from planting to maturity at an age of 10 years at a cost of from \$60 to \$80 per acre, figuring the wood as a waste product. With careful management the higher figure should include the cost of harvesting and marketing the crop.

It is an industry which will require large areas of land to insure most economical production, but large acreage will not demand the enormous capitalization usually associated with agricultural operations on a large scale in the Tropics.

#### INSECT ENEMIES.

The following insects are reported by the entomologist of this station, Mr. D. L. Van Dine, as occurring on the black wattle:

An undescribed species of weevil (*Bruchus* sp.) was taken from seeds purchased in San Francisco. It was presumably introduced into California from Australia or South Africa in the seed.

A leaf hopper (*Siphanta acuta*), known locally as the "torpedo-bug," is abundant.

The fluted scale of California (*Icerya purchasi*) has been noted, but because of the work of its enemy, *Novius cardinalis*, and possibly other predatory insects, it is only periodically in evidence.

A larva of an undescribed moth of the family Tineidæ is very abundant beneath the bark of dead or partly dead trees. The description and name of this insect will undoubtedly appear in the Microlepidoptera part of Fauna Hawaiiensis, which is as yet unpublished.

A long-horned beetle (*Cyelle crinicornis*) is abundant. This is a tropical species of wide geographical distribution, being recorded from Mexico, West Indies, Key West, Texas, etc.

*Xystocera globosa* is abundant. It occurs also in Japan, Philippines, East Indies, Madagascar, Mauritius, and Java.

*Sotenus setiger*, not abundant. Probably a native of the islands.

*Cresium simplex*, not abundant. Wide geographical distribution.

*Chalcolepidius erythroloma*, not abundant. A native of Chile.

*Xyleborus* sp., not abundant. Working in branches of felled trees.

Fuller's rose beetle (*Aramigus fulleri*) is quite destructive to the foliage of species of Acacia. For fuller details see Press Bulletin No. 14 of this station.