CHINA WOOD OIL

By MAXIMILIAN TOCH

This concludes a series of three papers on China Wood Oil which gives us what may be considered the most authoritative discussion of the subject that has been written to date. Recent investigations have so altered the situation in regard to China Wood Oil as to lend special importance to an exhaustive analysis such as this. On that account we requested and secured permission to reprint what appears as a chapter in the third edition of Toch's Chemistry and Technology of Paints. D. Van Nostrand & Company. New York.—*The Editor.*

It will be seen from foregoing pages that the archaic method of collecting seeds from trees that receive no cultivation or attention whatever produces variable oil, and that for the further reason that the nuts are allowed to rot and split, and then heated without any care as to uniform temperature. Many of our scientific statements are not to be relied on excepting for the particular sample examined, owing to the conditions of manufacture.

For fifteen years experiments have been made in an attempt to grow the tung oil in the United States, and to find a suitable climate for its propagation. There is no doubt that below Jacksonville in Florida any species of wood oil tree will prosper. There is no question that by obtaining seeds that grow in Hupeh and Szechuan Provinces which are 30 deg. North, trees can be grown which will prosper in Tennessee, Georgia and the Carolinas, but for the present Florida will give us a large quantity of oil, and a private corporation (Benjamin Moore & Co.) is planting between 2,500 and 3,000 acres adjacent to the plantations of the American Wood Oil Corporation.

It is very interesting to us that the oil produced from the seeds in Florida have different characteristics from the Chinese oil, but this is to be expected by anyone familiar with the transplanting of indigenous plants.

Tung oil produced in Florida in 1924 has the following characteristics and constants:

Percentages of Oil in Meat[1] (By Extraction)
64 Per Cent

Character of Oil Pressed from Meats

Color: very pale—almost water white	
Specific Gravity at 15.5° C.	0.941
Acid value in Alcohol-Benzol	0.0
Saponification value	194.3
Iodine value (half-hour, Wijs)	166.6
Refractive index at 25° C.	1.5193
Browne heat test (A.S.T.M.)—minutes	9¼

Fruits from S. Tarnok (Augusta, Ga.)

Character of Oil Pressed from Meats

Color: very pale—almost water white	
Specific Gravity at 15.5° C.	0.940
Acid value in Alcohol-Benzol	0.0
Saponification value	195.0
Iodine value (half-hour, Wijs)	165.6
Refractive index at 25° C.	1.5188
Browne heat test (A.S.T.M.)—minutes	9½

Sample of American Tung Oil

General appearance: golden yellow in color and very clear	
Specific Gravity (15.5° C.)	0.941
Refractive index (25° C.)	1.5195
Dispersion Value (25° C.)	0.02129
Acid Number in Alcohol-Benzol	1.13
Iodine Number (one hour Wijs)	175
Saponification value	195.5
Heat Test (100 gm. Worstall's)	6¾

The gel is very pale in color, dry and firm; cut and crumbled very well. This sample is pure tung oil of exceptionally good quality.

One half of this sample was sent to Dr. Z. Z. Zee at Columbia University whose analysis of this oil is as follows:

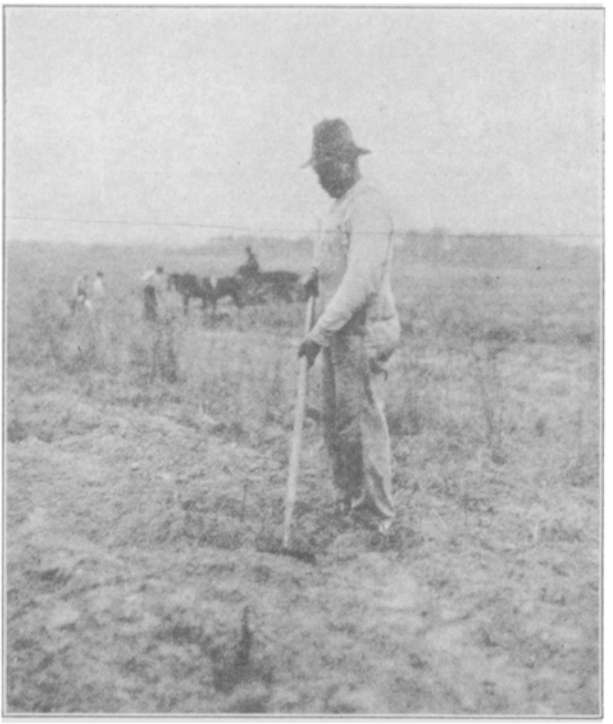
Color: very light amber	
Odor: faint but characteristic	
Sp. Gr.	0.9428 (at 15.5° C.)
Ref. Index	1.520 (at 25° C.)
Dispersion	0.02068
Acid No.	1.3
Iodine No.	174
Heat Test	9¾ minutes (Browne's Jelly test, heating at 282° C.

"The quality in my opinion is excellent."

When Havana tobacco from the Vuelta Abajo district, which is acknowledged the finest tobacco in the world, was transplanted to Connecticut and Wisconsin, totally different tobacco was produced which did not even appear like the original, and yet, from the coarse strong tobacco which was originally produced in Connecticut that sold at a few cents per pound, by selective transplanting and proper fertilizing, tobacco is being produced which commands as high, and in some instances, a higher price, than the original Havana tobacco. The transplantation of the French grape to California produced a wine twice as strong in alcohol as the original. Chinese cotton differs from the Egyptian and American cotton. Any indigenous plant transplanted in various parts of the world becomes either better or worse than the original, but it usually has an

Tong Oil Nuts grown in Gainesville, Florida. These cultivated nuts are about twice the size of the Chinese uncultivated nuts

entirely different taste, flavor, or characteristic. It is quite natural, therefore, that tung oil grown in America will be different from tung oil grown in China, and, from present appearances, it will be an oil that is going to be much more uniform and paler in color than anything grown in China. New formulae and methods will have to be devised, as the American oil polymerizes more rapidly and the addition of organic acids or possibly fatty acids in conjunction with rosin may have to be adopted in order to extend the time of polymerization or prevent it entirely, if possible.



One-year old tree, Florida

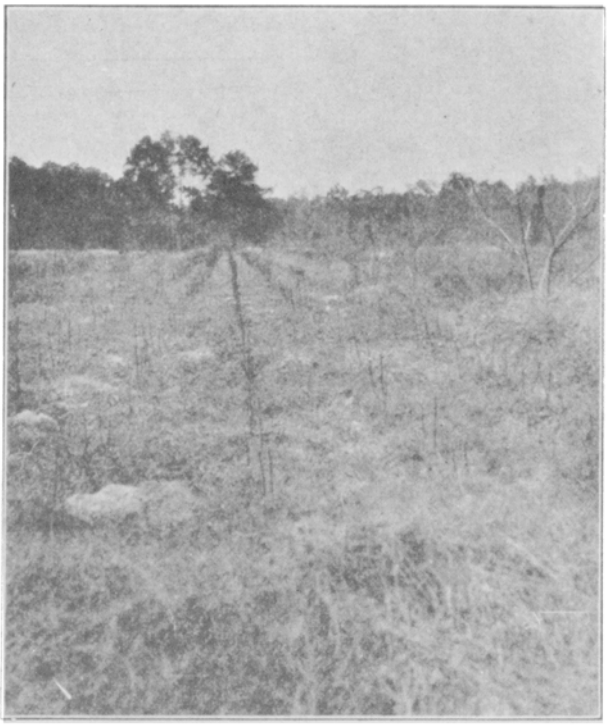
Unless China wood oil varnish is heated in a kettle above 260° C. and kept there without polymerization, the resulting varnish will only be good in the summer time but not good in our or in other winter climates; for instead of drying with a high gloss it flats selectively, and the only prevention for the flatting of China wood oil where it is not wanted, is to heat the oil without polymerization to a sufficiently high temperature and keep it at that in the presence of organic acids. Fatty acids of linseed oil and rosin are best adapted for the purpose.

The standard method for making wood oil varnish in the case of

rosin is 100 pounds of rosin to 400 pounds of wood oil, but in the case of rosin ester, the standard formula is 150 pounds of rosin ester to 400 pounds of wood oil.

Deodorization of China Wood Oil

It is possible to deodorize China wood oil and rid it of its pernicious characteristics, but up to now it has not been possible to do this on a

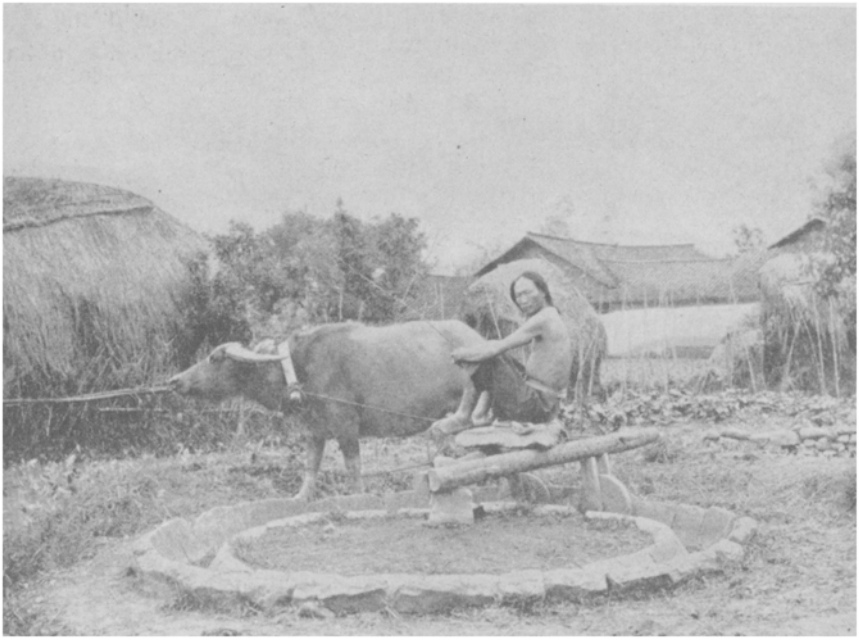


Planting Seedlings, Florida

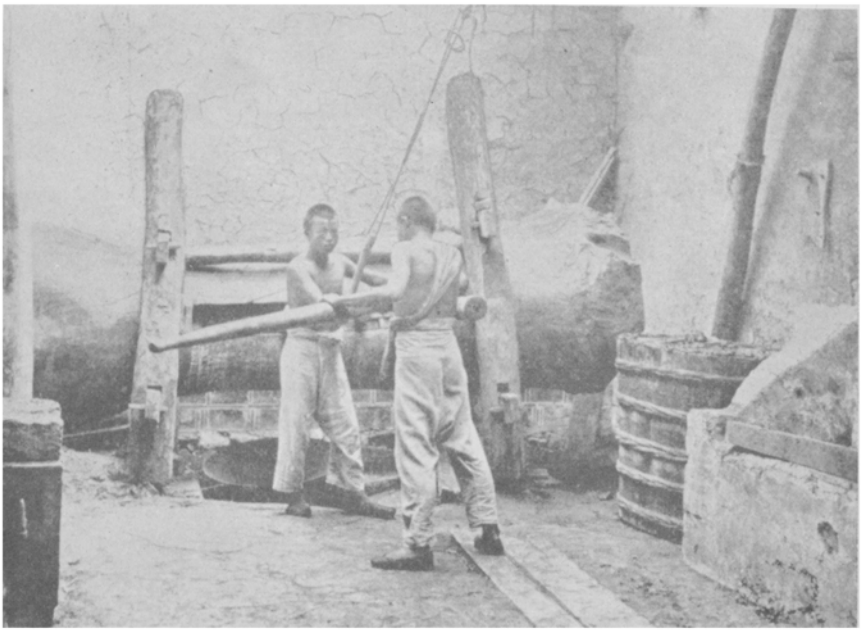
commercial scale, for there are many difficulties that arise in any process which attempts to extract the material that produces so-called "heathen smell."

China wood oil as grown in America has a very pleasant characteristic odor because the nuts are not allowed to rot and no decaying animal matter can possibly find its way into the American material, but on the Yang-tse River it has become essential to strain the oil as it is poured out of the baskets, through iron wire gratings in order to get rid of any foreign matter, including dead animals.

Starting out with the assumption that the odor is produced by some



Primitive Method of Grinding the Nuts



Chinese Boys Pressing Oil from the Nuts

material which has an analogy to butyric acid or a butyric compound, a large number of samples of oil were heated up to 150° C. and nitrogen and other inert gases were bubbled through them. In every case a reduction of the odor was noticed, but after the oil cooled and was allowed to stand in the light, it changed from a colloid to a crystalloid and, at first, crystals began to float around in the oil until, after 48 hours, the oil had the appearance of a soft wax.

A large number of experiments were tried, adding materials of carbonaceous nature, heating and blowing the oil at the same time, and after filtration the oil became crystalline, and in every instance this condition rendered it unsalable. Air, steam and some of the inert gases produce good results but the oil undergoes a change. This work is worthy for further study and experimentation.

Lumbang Oil

This oil will be suited for paint purposes as soon as care is exercised in the collection of the nuts, which grow in great quantities in the Philippine Islands. As yet, no definite statement can be made as to its constants unless a sample of oil is extracted from clean nuts, as such a sample will differ from the material that is imported into the United States at present. It has been used in some considerable quantities for the purpose of making putty, but there is no reason why it should not be used for paint, as it dries well, has a high iodine number, and, in spite of the method by which it is handled, it has a low acid number.

The specific gravity varies from .930 to .940; saponification value from 190 to 200; iodine value from 160 to 170.

Stillingia Oil

Stillingia oil is obtained from the seeds of stillingia sebifera, native to several parts of China. It is expressed from the seeds after the outer shell and mesocarp have been removed, and is generally of dark color, due to the primitive methods of extraction. Oil of a good pale color can be obtained by more modern treatment.

Tallow seed oil or vegetable tallow is expressed from the mesocarp surrounding the seeds. It is also obtained by pressing the entire nut, seed and all. This oil, which is not of much interest to the paint and varnish industry, is used in China as a substitute for cocoanut oil and tallow in the manufacture of candles and soaps.

Stillingia oil was formerly used only for lighting purposes, but is now widely used in China as both a substitute and adulterant for tung oil. Hard drying, glossy varnishes are made of it.

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1. Circular No. 125, "Amer. Tung Oil Culture," Henry A. Gardener.
2. Analyzed by Dr. T. T. Ling, Research Chemist.