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DEPARTMENT OF AGRICULTURE.
SPECIAL REPORT—No. 26.

REPORT
ON THE
CULTURE OF SUMAC IN SICILY,
AND
ITS PREPARATION FOR MARKET
IN
EUROPE AND THE UNITED STATES.

PREPARED, UNDER THE DIRECTION OF THE COMMISSIONER OF AGRICULTURE,

By WM. McMURTRIE, Ph. D.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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LETTER OF TRANSMITTAL.

WASHINGTON, D. C.,

June 30, 1880.

SIR: I have the honor to submit the following report upon "Sumac, its culture in Sicily, and its preparation for market in Europe and the United States." For the information relative to the Sicilian practices we are indebted to the valuable little work of Guiseppe Inzenga, of Palermo, Sicily, entitled *Manuale Pratico della Coltivazione del Sommacco in Sicilia*, to which we have been referred by the officers of the Italian Ministry of Agriculture, and an abstract of which was published in the *Bulletin Mensuel de la Société d'acclimation de Paris*, ser. 3, t. 4, 1877.

The representations of the botanical specimens of the different varieties were prepared from drawings made by Mr. George Marx of specimens furnished by Dr. George Vasey, Botanist to the Department,* and for the later information concerning the methods of collecting and curing the leaves at present employed in Virginia, we are indebted to Mr. German Smith, of Winchester, and Mr. John G. Hurkamp, of Fredericksburg. To the table of statistics of importations of sumac imported to the United States and taken from the report for 1877, I have added the figures for 1877, 1878, and 1879, reported by the bureau of statistics of the Treasury Department, from which source the other figures were originally obtained.

Respectfully submitted.

WM. McMURTRIE.

Hon. WM. G. LEDUC,
Commissioner of Agriculture.

* The cut of *Rhus pentaphylla* was kindly furnished by Dr. Asa Gray, of Cambridge, Mass.

THE CULTURE AND PREPARATION OF SUMAC IN ITALY.

The frequent requests made to the department for information concerning the culture of sumac in different parts of the world and its production for market, seem to render it advisable to bring together in a succinct and brief statement the authoritative knowledge that is obtainable on the subject. In such a statement it would be of no practical value to enter into the details of the origin and history of the family of plants which yield this product, and what has been recorded is of so meager a character that no very satisfactory conclusion to the study of this branch of the subject could be arrived at.

The plants yielding the commercial article known as sumac belong to the genus *Rhus*, and to the natural order *Terebinthaceæ* of the continental classification or *Anicardaceæ* of the English classification. Representatives of this genus may be found in almost every part of the temperate zones, but they do not all have the same value for the purposes of tanning, to which the product they yield has been applied since the time of Pliny, who appears to have described it. In a study of the tanning materials of the expositions of London in 1862 and of Paris in 1867, Wagner* found that the sumac from different sources was prepared from the following varieties of plants: *Rhus coriaria*, *Rhus cotinus*, *Rhus glabra*, *Rhus canadensis*, *Rhus typhina*, *Rhus pentaphylla*, *Arbutus uva ursi*, and *Coriaria myrtifolia*. These several varieties are thus distributed among the different countries placing the product on the markets:

SICILY.—*R. coriaria*.

ITALY (Tuscany).—*R. coriaria* (often adulterated with leaves of *Pistacia lentiscus*).

SPAIN.—Several varieties of *Rhus*; appears in the markets as three varieties: Malaga or Priego, Malina, and Valladolid.

THE TYROL.—*R. cotinus*.

FRANCE.—*Coriaria myrtifolia*, divided into four varieties: (a) *Fauvis*, (b) *Douzère*, (c) *Redoul* or *Redon*, (d) *Pudis*.

ALGERIA.—*R. pentaphyllum*, Tezera sumac, used by Arabs for making Morocco leather.

NORTH AMERICA.—*R. glabra*, *R. canadensis*, and *R. typhina*.

* Wagner's *Jahresbericht der Chemischer Technologie*, 1871, 389, and *Jahresbericht der Chemie*, 1872, 1019.

SWITZERLAND.—*Arbutus ura ursi** (often mixed with leaves of *Vaccinium vitis idæa*).

None of these varieties have been successfully introduced into this country for extended cultivation, for all attempts at their acclimation have resulted in failure on account of the severity of the winter season. Experience has, however, fully demonstrated the value of our principal American varieties for tanning purposes; and as we are thoroughly satisfied that they may be recommended on this account, and because of their extreme hardness, our remarks will be confined principally to them, and no further mention will be made of the European varieties with reference to their cultivation in the United States.

The *R. canadensis* mentioned by Wagner is not generally known, and the varieties especially employed in this country are as follows:

Rhus typhina, staghorn sumac, growing 10 to 30 feet high.

Rhus glabra, smooth or white sumac, growing 2 to 12 feet high.

Rhus copallina, dwarf or black sumac, growing 1 to 7 feet high.

Rhus cotinus, fragrant sumac, is also a dwarf like the *copallina*, and the name of these two varieties are often confounded.

The values of these two varieties for tanning purposes is about the same. Other varieties growing in different parts of the United States are mentioned by a writer in the Report of the Department of Agriculture for 1869, but as the quantity of the yield from them will not be sufficient to render them commercially valuable, we omit any further description of them.

The external characteristics of the leaves of the different varieties we have mentioned may be seen in the accompanying illustrations from drawings by Mr. George Marx of specimens prepared by Dr. George Vasey, Botanist to the Department of Agriculture; to whom, also, the botanical descriptions are to be credited as well.

Sumac grows spontaneously in such large quantity in various sections of the country, on poor, rough, and abandoned lands and hill-sides, that it has never been subjected to cultivation; yet it would appear that, as a matter of culture, it would prove a profitable crop. Of the varieties mentioned, *Rhus glabra* is the most valuable for tanning purposes, and therefore that which we would recommend for cultivation; though, on account of its smaller size, the *Rhus copallina* might be found very convenient, and its value is not much below that of the other. As stated with reference to the Sicilian variety, the leaves are the parts of the plant industrially employed.†

The wood contains a yellow coloring matter, extractable by means of a dilute solution of potash or soda, which may be separated from its

* Kawalier (*Jour-für prakt. Chemie LVIII*, p. 195), found that the leaves of *Arbutus ura ursi* contained considerable percentage of gallic acid, but only traces of tannic acid. (Wagner.)

†E. Coez & Co., St. Denis, near Paris, manufactures sumac extract, which is sold through E. Javal Bros. & Co., in Hamburg, at 16 thalers per centner. The sumac extract concentrated in a vacuum-pan to a sirupy consistency keeps well, and does not exhibit the acidity which is manifested in a simple decoction of sumac leaves.

alkaline solution by careful neutralization thereof with an acid. A similar product obtained from oak bark is known in the market as a yellow dye under the name of *flavine*, and consists of a mixture of quercitrin and quercetin, sometimes used as a substitute for fustic. The wood has never attained any commercial importance on this account, nor is it probable that it will ever enter into competition with oak extract or fustic wood.

In cultivation of the plant, on account of its power to withstand dryness, the soil usually chosen is poor and light; but a much larger crop of leaves can be secured from strong, rich, deep soils, and it is generally admitted that the product in the latter case is also better. In Italy limestone soils are considered to be especially suited to this culture, but our American varieties appear to be well suited to sandy and clay soils as well. The primary requisite in a soil is that it should be well drained, the presence of stagnant water about the roots having been found exceedingly prejudicial to the health of the plant.

To prepare the soil for planting it should be plowed as deeply as possible, and laid out in rows about 2 feet apart. In Italy small holes are made about 2 feet long, 7 inches wide, and 5 inches deep, and a plant is inserted at each end. A more convenient method for planting would, however, consist in marking the field in shallow furrows in one direction 2 feet apart, and then marking with a heavy plow tolerably deep furrows the same distance apart and at right angles with the first. A plant may then be placed in the deep furrows at each intersection, the furrow again filled with the plow, and the earth pressed about the plant with the foot. And if this work be done in early spring-time, as soon as the earth is just sufficiently dry to be conveniently worked with a plow, there can be no doubt that it would be successful, while it would certainly involve little cost.

Plants are generally propagated from the young shoots which form each year about the base of an older plant, but they may also be produced from cuttings made from young but well-ripened wood, rooted by setting in nursery or frames in the same manner as in the propagation of grape vines from cuttings. This latter method is scarcely ever required, however, when the cultivation has been started, because the shoots from about the base of growing plants are so numerous, and rooted subjects from this source are so readily obtained. Plants are also produced from seed, and seedlings are always found to be strong, vigorous growers, and thoroughly hardy, but on account of the greater time and labor involved in their production this method of propagation has not received extended application. The first method mentioned is that which will generally give quickest, and probably, all things being considered, the most satisfactory results.

In selecting plants from any source there are certain points to be observed.

1. The shoots should come from young and vigorous plants.
2. They should be over one foot long.

3. Those with large roots and few rootlets should be rejected.

4. Shoots having white roots, even though they may appear strong and robust, covered with a fibrous, white, silky down, are also to be rejected. The condition described is an indication of the presence of a subterranean parasitic fungus, very injurious to the plant, capable of spreading to other plants and destroying the entire crop.

5. A good shoot is one which is straight, of at least $\frac{1}{2}$ inch diameter, 18 inches long, furnished with numerous buds close to each other, root short, but covered with rootlets.

The shoots for planting may be collected in autumn, after the leaves have fallen, and be preserved in nursery until spring; or this may be done in early spring, when the ground is very moist and soft. In either case care should be observed that the rootlets are not injured by drying or from any other cause.

For starting the culture in this country with our native varieties, shoots may possibly be obtained from sections where plants are growing spontaneously; but, should this be impossible, then, as before observed, cuttings may be made and rooted in frames. For this purpose young, well-ripened wood should be taken in the fall and cut in sections 8 or 10 inches long and put in sand in warm frames and kept moist until the roots are formed. They may then be put in good earth in pots or beds until time for planting in open field in the spring. If possible, the temperature of the lower portion of the sand should be maintained considerably higher than the surrounding atmosphere, and should be at least 70° F. Such conditions are suited to promote the production of roots.

The culture to be given the plant is somewhat similar to that required by Indian corn; that is, the earth about it should be kept tolerably mellow and free from weeds, and such conditions can probably be maintained to a degree sufficient for sumac by working several times during the growing season with a cultivator and passing through the rows occasionally with a plow. All this work is not absolutely necessary to the life of the plant, but its vigor and consequently its yield in leaves may be very considerably increased and strengthened thereby. After the first year the number of operations may be diminished, but they should always be sufficient to keep the ground free from weeds and grass.

Shortly after planting, and when the plant is well set, the stock is pruned to a length of 6 to 8 inches, when the plant is left to assume any form, and is no further pruned except by the process of collecting the leaves, unless hand-picking is resorted to, and in such case, after the second year, pruning takes place each year in the fall or winter, the plant being reduced to a height of 6 to 10 inches. After the third year the plant begins to produce the shoots from about its base, already mentioned, and these should, if they are not needed for new plantations, be removed each year, for if left to develop they have a tendency to weaken the plant.

If they are not removed during the summer, the operation should, without fail, be effected during the fall or winter.

The first crop of leaves may be secured during the year following that of planting. This crop develops and matures somewhat later than that from older plants, and in Italy it is not collected until the end of August or the first of September, but there are reasons for believing that in this country, and especially in the Northern States, the collection of leaves from our native varieties should be made much earlier; first, because the summer is much shorter, and second, because the habits of the varieties grown differ from the Sicilian variety. We should therefore recommend that this collection be made not later than the month of July or the first half of August. This, it must be observed, applies to leaves of plants one year after planting.

At the time mentioned all the leaves, except the young and tender ones of the extremities of the branches, are stripped off and placed in baskets, in which they are carried to a thrashing-floor, where they are spread out in thin layers to dry. Here they must be frequently stirred and turned over, and for this purpose a fork with wooden prongs must always be employed. In the fall, when growth is finished, and before the leaves have had time to become red, those remaining on the extremities are collected. To this end the branches are broken just below the tuft of leaves, and the latter allowed to remain suspended to the branch by a piece of bark not detached, and left in this condition until nearly or quite dry. They are then collected and treated in the same manner as other leaves, but the product obtained in this way is always of inferior quality.

After the second year, crops of larger quantity and superior quality are obtained, and the collection is made in a different way and much more frequently, and the two methods followed in Sicily are as follows:

1. By pruning.
2. By defoliation.

The first, which is the most ancient, but which is much less costly, requires less care than the second, is simple and rapid, but injurious to the future condition of the plant and the quantity of subsequent crops. The second, though slower, serves to better maintain the vigor of the plant and the uniform quantity of the crop from year to year, and in consequence thereof reduces the necessity for frequent renewal of stocks.

Harvest by pruning is carried on in Italy as follows:

During the month of May the lower leaves, which, from greater age, appear to have attained full maturity and may be in danger of loss from falling, are removed in the same manner as that described for collecting the leaves from yearling plants. Toward the end of June and during the course of July all branches bearing leaves are cut away, reducing the plant to the principal stock, and by this means the crop is harvested and the plant pruned at the same time. But even in Sicily the time for this operation is limited to no absolute date or period, and varies with

the development of the leaf as indicated by cessation of growth and increase in size. In this condition, also, the leaves will have acquired their deepest green color and attained their maximum weight and best quality. It is further stated that while this time varies according to countries, about Palermo it is never earlier than June nor later than July.

The harvest by pruning must always be made by men accustomed to the work and equal to the exertion required. Provided with a pruning bill, they cut off all leaf-bearing branches, collecting them on the left arm, until each has cut as much as he can conveniently carry, when he places the armful on the ground with the butts in the direction of the prevailing wind, which, if tolerably strong, might carry away some of the leaves if turned in the opposite direction; and, finally, he presses down the branches with the foot to make the heap more compact and leave less surface exposed to the wind and sun. Another laborer deposits a second armful in the same place, presses it with his foot in like manner as before, and the two deposits constitute a bundle. At the close of the operation there remain the young shoots which are formed about the base of the plant, the leaves of which are not fully developed, and consequently not fit for collection until at least twenty days later. After this time they are removed by hand, care being observed not to injure the buds, especially if the shoots are to be used for stocks in the formation of plantations of the following year.

The second method mentioned, defoliation, or collection by hand, is carried on whenever the leaf may be fully developed and ripe, beginning at first with the lower leaves and continuing eventually to the ends of the branches, and takes place at three different times during the season; the first in May, the second late in July or early in August, and the third in September. At the last collection the extremities of the branches are broken down and the leaves allowed to dry before removal from the plant, as described under collections of the second year.

In the application of the second method the regular pruning is effected during the fall or winter, when the plant is dormant, and under such conditions the operation becomes a regenerative one, giving in this particular an advantage over the other method in which the pruning is effected in the summer when the plant is in full vegetative activity, and so has a strongly deteriorating influence. In both methods of pruning care should be observed to leave a long slanting section upon which water will be less likely to settle and promote decay, to the injury of the plant.

The leaves collected by either of the methods described are dried in the open field where they have grown, and, when dried, are carried to a thrashing-floor to be beaten, or they are carried at once to the thrashing-floor and dried there. In the first instance the operation is rather more rapid, but there is greater danger of injury by rain, the effect of which is very deleterious, especially if it fall upon the leaves when they are partially dried. The damage resulting from this cause is always less if

the leaves are not lying upon the ground, and are so arranged that the air may circulate freely about and under them. In the pruning method the leaves are dried upon the branches and in the heaps where they are first deposited. Sometimes they are turned, but, as a general thing, it is considered better not to disturb them until completely dried and ready for transportation to the thrashing-floor. In this way they are protected to a greater extent from the action of direct sunlight, which is said to be injurious to the quality of the product. When the leaves are collected by hand they are dried upon the thrashing-floor, where they are spread in thin layers and frequently stirred three or four times a day. The raw product thus secured, when perfectly dry, is placed on the thrashing floor, which in Italy is a space of ground, generally circular, the surface of which has been made level, and has been packed very hard. It is here beaten with a flail to separate the leaves from the branches and stems. If this be done during the middle of the day when the leaves are most thoroughly dry and consequently brittle, they are reduced to small particles, producing what is called *sumac for grinding*. But if it be done in the morning or on damp days, when the air is charged with moisture and the leaves are tough, they are separated from the stems more nearly entire and less broken, and the product obtained is called *sumac for baling*. The stems remaining after separation of *sumac for baling* still retain small particles of leaves attached to them, and they are therefore again beaten when perfectly dry for the production of a low-grade sumac, called by the Italians *gammazza*. These are the methods followed in Italy, and the products are classed as follows:

Class.	Relative market value.
Sumac for baling.....	2.5
Sumac for grinding.....	2.3
Sumac from yearling plants.....	1.5
Sumac from ends of branches collected in autumn.....	1.0

To prepare these different grades for ultimate consumption, they are ground in mills similar to those employed for crushing olives, that is, in which two large stone wheels follow each other, revolving upon a circular bed, the whole construction being about the same as the Spanish or Mexican *arrastré* used for crushing and amalgamating gold ores. The sumac thus pulverized is then passed through bolting screens, to separate the finer from the coarser particles.

In this country, where sumac is manufactured—and this is done more extensively in Virginia than elsewhere—the leaves are collected and cured by the country people and sold and delivered to owners of mills for grinding. Their particular object being, of course, to secure the largest possible quantity of product at the lowest cost, little attention is given to the quality obtained or the manner of collecting.

The most intelligent dealers in the raw material urge upon collectors to observe the following particulars, and even endeavor, by selection of the product when buying, to force them to do so: The leaf should be taken when full of sap, before it has turned red, has begun to wither, or has been affected by frost, to insure a maximum value for tanning pur-

poses. Either the leaf-bearing stems may be stripped off or the entire stalk may be cut away and the leaves upon it allowed to wither before being carried to the drying shed, but care must be observed that they are neither scorched nor bleached by the sun. When wilted, they are carried to a covered place and spread upon open shelving or racks to dry, and the precaution here involved is a necessary one, and avoids the deposit in any one place of a quantity so great as to cause danger to the quality of the product by overheating and fermentation. It secures the double advantage of allowing free circulation of air through and about the leaves and provides a large drying surface within a comparatively small space. Sumac should be allowed to remain within the drying-house at least one month before sending to the market, and in case of bad weather a longer period may be required. When ready for packing for shipment it should be perfectly dry, and, consequently, very brittle, otherwise it is likely to suffer injury in warehouses from heating and fermentation.

Buyers of sumac leaves for grinding depend largely upon their color for the determination of their value, and they should therefore, when ready for market, present a bright green color, which is an evidence that they have suffered from neither rain after being gathered nor from heating during the process of drying. Leaves having a moldy odor or appearance are, of course, promptly rejected.

The price of the raw product, as delivered to the mills this year in Virginia, will range about 75 cents per hundred pounds, and the quantity will probably reach 7,000 to 8,000 tons, and this is collected at any time between July 1 and the appearance of frost.

The amounts and values of the annual importations of foreign sumac to the United States, the time best suited to making collections for securing a given quality of product, and the present methods employed for preparing sumac for consumption in the arts, may be gleaned from the following abstracts from the results of my investigations, published in the Annual Report of the Department for 1877 and from an article in the report for 1869, which we deem it of value and interest to introduce here:

Table showing the quantity and value of the annual importations of foreign sumac to the United States since 1867.

Year ending—	Quantity.	Value.
	<i>Pounds.</i>	
June 30, 1867.....	13, 790, 990	\$559, 421
1868.....	11, 842, 451	468, 362
1869.....		536, 083
1870.....	9, 634, 367	418, 919
1871.....	10, 341, 787	420, 823
1872.....	10, 028, 912	383, 570
1873.....	13, 160, 114	463, 780
1874.....	16, 718, 678	511, 941
1875.....	16, 542, 548	533, 713
1876.....	17, 642, 960	621, 169
1877.....	21, 430, 641	736, 390
1878.....	15, 668, 581	508, 247
1879.....	12, 981, 675	394, 631

"We see, therefore, that the annual consumption of the foreign product approximates 8,000 tons. This does not take into account that brought in by smuggling and false entries, which is said to be very considerable."

"There is another important comparison to be made here, viz., the difference in the value of the foreign and that of the home product. The value of the importations for 1876 amounts to the sum of \$624,169 gold, while the value of the American product will not exceed \$420,000 currency. Later advices from a private source state that the importation of sumac for the present year amounts to 11,000 tons, or \$1,100,000 gold, estimating the value of the product at \$100* per ton. Yet it has been conclusively proven that the proportion of tannic acid in the latter exceeds that found in the former by 6 or 8 per cent. It has often been stated that this difference in favor of the American product is very much greater, but my own investigations have failed to confirm such statements, and I have been unable to find any reliable analyses that support them. Notwithstanding this higher percentage of tannic acid in the American product, we undertook this summer to determine at what time during the season it is at the maximum, in order, by giving instructions concerning the time for collection based upon results of such investigation, to bring about a possible improvement in the product. At the same time, it was obvious to us that we must look for some other source for the main cause of the difference in the values of the American and Sicilian productions, and why the latter is so much preferred by tanners and dyers. Upon inquiry among the dealers and practical tanners, we find that by using sumac of Sicilian growth and manufacture it is possible to make the finer white leathers so much used for gloves and fancy shoes, while by the employment of the American product the leather resulting has a disagreeable yellow or dark color. Many attempts have been made by those interested in collecting and grinding, by careful attention to the methods employed, to improve the quality of the home product and save the extra \$50 per ton, which is the present difference between the prices of American and Sicilian sumac."

"In many cases these attempts have been partially successful, but not entirely so, and, as will appear below, the difficulty in question cannot be altogether remedied in this way. Since the present analyses, and those published elsewhere, show a higher percentage of tannic acid in favor of the American product, it is evident that the difficulty must depend entirely upon a coloring matter, which, according to Loewe (Fresenius's *Zeitschrift für Analytische Chemie*, 1873, pp. 127, 128), consists of quercitrin and quercetin, which exists in larger quantity in the American than in the Sicilian."†

* American market price.

† In the progress of my work I succeeded in separating a brown crystallized substance in the following manner: An extract of 100 grains of Fredericksburg sumac,

"Endeavors were made to determine a ready and practical mode by which the separation of these coloring matters from the tannic acid in solution and their estimation might be effected, but from the fact that their deportment with reagents is so similar to that of tannic acid, and their solubility in water appears to be so much modified by the presence of tannic acid, our endeavors to this end were unsuccessful. But while there may be no practicable method which may be applied to the separation of the coloring matter when in solution, we believe we have discovered how it may be entirely avoided. The manner in which this may be effected will appear later on."

"In the mean time, let us compare the percentages of tannic acid in the product, as indicated by our estimations in specimens collected at stated intervals during the season. Through the courtesy of Mr. German Smith, of Winchester, Va., samples of sumac were collected in the months of June, July, and August, respectively. Of these samples, those collected in June and July were mixed varieties, and of the product collected in August we secured samples of the leaves of *Rhus glabra* and *Rhus copallina* separately. For comparison with the Virginia material and for use in the latter portion of the work, we applied to Mr. William S. Soule, of Boston, Mass., for a sample of Sicilian sumac, and he very kindly and very promptly supplied it. In all of these samples the tannic acid was estimated by means of the method of Jean, published in the *Bulletin de la Société Chimique de Paris*, and mentioned in the Annual Report of the Department for 1876."

"I may state here that I found it convenient to modify somewhat the method as laid down by Jean. For instance, a decided improvement was experienced by increasing the strength of the iodine solution from 4 grams iodine per liter to 8 grams per liter, and with the solution of this strength I obtained exceedingly satisfactory results."

"For the analysis, I took 5 grams of each sample, placed them respectively in a casserole, poured upon them about 150 cubic centimeters of distilled water, and heated to boiling about fifteen minutes. After partial cooling and settling, the solutions were poured through linen filters and the residues treated in a similar manner with water, until all tannic acid was extracted. After the last boiling, the whole was placed upon a filter, and when the liquid had nearly all passed through, the portion remaining was forced through by pressure. The solutions were then made up to 500 cubic centimeters, and for each assay 10 cubic centimeters

containing 23.71 per cent. of tannic acid, was treated with solution of plumbic acetate, and the resulting precipitate, after separation by filtration and washing, was rubbed up with alcohol, and finally placed in suspension in a large volume of alcohol, through which sulphuretted hydrogen gas was subsequently passed, until complete decomposition of the lead compound was effected. After separating the sulphide of lead and slightly concentrating the alcoholic solution, the crystals formed. The crop obtained was not sufficient for complete examination, and the substance must, therefore, be the subject of future investigation.

were taken. The results obtained are indicated in the following table:

Variety.	Time of collection.	Percent- age tan- nic acid.
Winchester mixed	June	22.75
Do.	July	27.38
Winchester <i>Rhus glabra</i>	August	23.56
Winchester <i>Rhus copallina</i>	August	16.99
Sicilian <i>Rhus coriaria</i>	August	24.27

"It is evident, therefore, that in order to secure the maximum amount of tannic acid, the sumac should be collected in July."

"But, as before stated, the coloring matter of the leaves has an important influence upon the value of the product, and it appeared of value to determine when it was present in smaller quantities."

In this connection, and in corroboration of the results we have obtained, we may quote the following article from the *Journal d'Agriculture Pratique* (1880, I, 514), by Prof. N. Macagno, director of the agricultural station of Palermo, in Sicily. The results show that the higher percentage of tannic acid obtains about the 1st of July, and in the younger leaves.

"Among the plants furnishing products of industrial interest, certain species of *Terebinthaceæ*, the *Rhus coriaria* (vulg., sumac), the *Rhus cotinus* (vulg., fastic), and the *Rhus vernix* (vulg., Japan varnish) are well known on account of the tanning, coloring, medicinal, and resinous substances they produce in their stalks and leaves."

"In the south of France (*Alpes maritimes*) and Western Liguria (Italy) fastic is cultivated which gives an aromatic and astringent bark, employed as febrifuge, and a wood used for dyeing goods orange yellow. In Sicily very large exportations are made of dried and pulverized sumac, which gives a good and abundant product in soils well exposed to the sun, even with little care on the part of the grower."

"Leaves of this valuable shrub furnish a tanning material widely used and esteemed in the manufacture of moroceos. The crop is collected in July and August when the leaves tend to become yellow on their edges. They are dried in the air, pulverized, and put in sacks for market."

"I have made researches on the formation of tannic acid in the leaves of sumac in 1879 by successive analyses made during the period of growth. The results calculated for 100 are as follows:

Date.	Water in leaves.		Tannin in leaves.		Averages.	
	Upper.	Lower.	Upper.	Lower.	Water.	Tannin.
June 10, 1879	58.15	60.23	24.93	17.45	59.19	21.19
June 16, 1879	57.21	63.40	24.92	16.11	60.30	20.51
June 27, 1879	52.47	63.44	25.82	15.27	57.95	20.54
July 14, 1879	51.15	62.24	24.75	10.81	56.69	17.78
July 29, 1879	49.80	60.33	23.80	9.44	55.06	16.62
August 11, 1879	48.15	61.80	21.91	8.77	54.97	15.34
Averages					57.36	18.66

The determinations of tannin were made by the method of Flek, modified by Simpkin, with ammoniacal acetate of copper.

"The results show, 1st, that leaves of sumac of the upper extremities of the stalk are always richer in tannic acid than those of the base; and, 2d, that the increase of age of the plant and its parts is accompanied by a general diminution of this acid. Yet, in the interest of cultivators, the collection of the crop should be delayed as long as possible, because the diminution of tannin in the leaves will be abundantly compensated for by the quantity of the product."

"In my work it at first seemed reasonable to suppose that leaves from the young growth of wood, in which the coloring matter is not yet formed as in the older wood, might be collected and found free from this troublesome substance, but examinations proved that this was not the case. I therefore determined to make some experiments upon the color of precipitates with gelatine, made by means of solutions of the material collected in the different months, having the same strength in tannic acid for each."

"For the purpose of experiment, the qualities indicated in the following table were taken, and to each specimen was added about 150 cubic centimeters of distilled water, and boiled about fifteen minutes, filtered through linen, and pressed out without washing, replacing the water which had been removed by evaporation during the boiling and otherwise, making the volume of each solution up to 150 cubic centimeters:

Variety.	Date of collecting.	Amount taken.
Winchester mixed.....	June.....	Grams.
Do.....	July.....	4.4
Winchester <i>Rhus copallina</i>	August.....	3.65
Winchester <i>Rhus glabra</i>	August.....	5.8
Sicilian <i>Rhus coriaria</i>	August.....	4.25
		4.1

"The gelatine solution employed contained 5 grams in 50 cubic centimeters of water. In the experiments I took 50 cubic centimeters of each sumac solution and added thereto 10 cubic centimeters of the solution of gelatine. The colors of the precipitates obtained were as follows:

Variety.	Collected.	Color of precipitates.
Winchester mixed.....	June.....	Nearly white.
Do.....	July.....	Decidedly yellowish white.
Winchester <i>Rhus copallina</i>	August.....	Dirty yellow.
Winchester <i>Rhus glabra</i>	August.....	Very dirty white.
Fredericksburg mixed.....	August.....	Dirty yellow.
Sicilian.....	August.....	White, slightly yellowish tinge.

"In some of the tests the precipitates obtained by means of the solution of the June collections of Winchester mixed sumacs were perfectly white, and very much cleaner than any obtained with the Sicilian prod-

uct. The difference in the color of the precipitates obtained from the solution of the June collection and that obtained from solutions of the samples of later collections was sufficiently marked to prove that the great difficulty in the way of the universal employment of the American to the exclusion of the expensive Sicilian product *may be obviated by making our collections early in the season*; that is, in the month of June. The percentage of tannic acid is not, it is true, quite as high as obtains in July, but it compares favorably with the Sicilian product, which, be it remembered, communicates a slightly yellowish tinge to the gelatine precipitate. The amount of coloring matter found in the July collection is sufficient to account for the difference of \$50 per ton in the market values of the sumac of home and foreign growth, regardless of the proportion of tannic acid. We would, therefore, advise that for the purpose of tanning white and delicately-colored leathers the collection be made in June, while for tanning dark-colored leathers, and for dyeing and calico printing in dark colors, where the slightly yellow color will have no injurious effect, the collection be made in July. It appears that for all purposes the sumac collected after the 1st of August is inferior in quality."

"In view of the facts here presented, we cannot help urging upon manufacturers the importance of encouraging the home production; of insisting that the collections be made early in the season, in order thus to bring about such a change in this matter as to prevent the annual expenditure of over \$600,000 in gold for the sumac of foreign growth. They may insist upon a classification depending upon the time of collection and the behavior of aqueous solutions of the material with solutions of gelatine. They might also insist upon a guaranteed percentage of tannic acid. By encouragement of home trade and home productions, there is no reason why the enormous annual expenditure above referred to should not be saved to American producers."

"If the classifications mentioned were required, those interested in the collection would take care to secure the best quality in the product by the means here shown to be at their command, while merely an offer of an advanced price, which the consumers can readily afford, would doubtless be sufficient to bring this about, and at the same time induce others to engage in the enterprise of collection, so that in a short time the home supply would be not only ample to meet the home demand, but also to make a good surplus for export to foreign markets. And all this may be secured from a spontaneous growth upon lands that would otherwise be almost utterly worthless, and with no immediate demand for the cultivation of the shrub."

"The importance of the matter also warrants the encouragement on the part of our legislators in Congress by the increase of the rate of duty now imposed upon the importations of sumac. Such increase should not be made of immediate effect, but should be deferred until after the

1st of August of the coming year. No inconvenience would be then felt by consumers on account of deficient supply to meet the present demands and the advanced cost consequent thereupon, while the increased supply of the home product that must follow such encouragement would be sufficient to meet future demands."

In connection with this subject, a synopsis of the method of grinding and separating the different grades of sumac, which is described in the Annual Report of the Department for 1869, may be of some interest.

Through Mr. Cornelius S. Ramsburg we have secured specimens of the products from the different stages of the process employed, and have taken occasion to estimate their value with reference to the tannic acid they contain. The raw material as brought to the mill (a complete description of which we give below, quoted from the Annual Report for 1869) is passed through the grinding apparatus, and from this, after grinding, is passed through a revolving screen, divided into two sections, the first of which is provided with a sieve with 36 meshes per square inch, while the second part has but 9 meshes per inch.

"A mill for grinding sumac leaves consists of a heavy solid circular bed of wood (marked A in the accompanying engraving), 15 feet in diameter, with a depression around the edge B, a few inches deep and a foot wide for the reception of the ground sumac from the bed, and two chasers or rollers, C C, weighing about 2,500 pounds each, 5 or 6 feet in diameter, and provided with teeth of iron, or preferably of wood, thickly inserted. If the axle of a cart were set upon a pivot in its center, the wheels of the cart would describe a compound revolution similar to that of the chasers of a sumac-mill. Most mills have to be stopped to allow the unloading of the bed, but a process, exhibited in the accompanying engraving, has been patented by Mr. Chase, of Alexandria, Va., which obviates this delay. The apparatus consists of an angular arm, D, attached to a scraper, E E, and worked by a lever, F, which passes through the hollow shaft G and extends to the room above, where it terminates in a handle, as seen in the section at the top of the engraving. The scraper carries the ground sumac to the opening H, whence it is carried by the elevator, marked in the second engraving I, such as is common in flour-mills, to the revolving sieve or screen K, in a room above. After screening, the sumac passes down through the tube L, and is packed in bags, fifteen to the long ton (2,240 pounds): this article being always sold by that weight. The chasers and beds are inclosed in a huge case or drum, M M, and the grinding is done by the application of power to the upright shaft G, between the chasers, and which moves them. The mills are fed from above. The packing is sometimes done by machinery alone. This description is of the best mills, which cost about \$3,000."

In Europe and in some parts of the South sumac is still ground by stones revolving on a stone bed, and the sifting is often done by hand.

SUMAC MILL.

SUMAC MILL.

"The products resulting in this country are:

"1. Ground sumac, grade No. 1."

"2. Fine stems and unground particles of leaves."

"3. Coarse stems."

"The second product is again passed through the mill, and the useful product resulting is ground sumac, grade No. 2."

"No use is made of the coarse stems; but it has been suggested that, on account of the considerable proportion of yellow coloring matter they contain, they be employed in the production of flavine. Whether they may be thus applied must be the subject of future experiments."

"Estimations of the tannic acid in these several products gave the following results:

	Per cent.
No. 1 sumac.....	26 to 28
Exhausted stems.....	6.14
No. 2 sumac.....	14.72"

"The quality of the No. 2 sumac is often improved before sending it to the market by admixture of that grade No. 1 sufficient to increase the proportion of tannic acid in it to 18 or 20 per cent."

"Mr. Ramsburg's kindness has also enabled me to make estimations of tannic acid in varieties of sumac which grow extensively in Virginia, other than those analyzed and mentioned in the previous tables, and he has brought in specimens of *Rhus glabra* and *Rhus typhina*. In the following table we compare the percentage of tannic acid they contain with that found in the *R. glabra* and *R. copallina* of Winchester. They were all collected in August, and do not give a maximum yield, but the figures below will serve to a certain extent to compare them:

	Per cent.
<i>R. typhina</i> , Georgetown, D. C.....	16.15
<i>R. glabra</i> , Georgetown, D. C.....	16.50
<i>R. glabra</i> , Winchester, Va.....	23.56
<i>R. copallina</i> , Winchester, Va.....	16.99"

"These estimations should be duplicated the coming year upon specimens collected at favorable seasons. It is probable that a comparison between the varieties might lead to some facts of great value to collectors and dealers."

SUMAC.

The bushes or small trees yielding sumac belong to the genus *Rhus* of the natural order *Anicardiaceæ*. The genus is a large one, comprising about 120 species, growing in different parts of the world. Some species furnish a resinous juice, which in a Japan species (*Rhus vernix*) is used in the preparation of varnish and lacquer. A number of species are more or less poisonous, among them the plant commonly called poison ivy (*Rhus toxicodendron*), and another called swamp dogwood (*Rhus venenata*). The genus may be briefly characterized as follows:

RHUS.—Trees or shrubs, with leaves alternate, and either simple or commonly pinnate, with small flowers in panicles. The calyx is 5-parted and persistent, the corolla of 5 petals, which are imbricated in the bud. There are 5 stamens, inserted on a minute flattened disk or ring in the bottom of the calyx, and in the center rises the one-celled ovary with 3 styles. The fruit is a kind of a dry drupe, or a small stony fruit, with a dry or dryish covering. The flowers are mostly of a greenish-white color.

Our native species belong to a section which has polygamous flowers in a terminal thyrsoid panicle; the fruit globular, clothed with acid crimson hairs; the stone smooth; the leaves odd-pinnate.

PLATE III.

RHUS TYPHINA L. Staghorn Sumac.

Young branches and leaf stalks densely covered with soft velvety hairs, the leaves sometimes a foot in length and 6 inches in breadth, composed of from 5 to 12 pairs of leaflets, which are oblong-lanceolate, long pointed, conspicuously toothed on the margin, of a bright green color above and pale beneath. The panicle of flowers and fruit is usually about 6 inches long at the apex of the branches.

It is usually a shrub 8 or 10 feet high, but sometimes attains the height of 20 or 30 feet. The wood is of an orange color.

mu'x. Del

RHUS TYPHINA, L.

PLATE IV.

RHUS GLABRA L. Smooth Sumac.

Young branches and leaf stalks smooth and sometimes with a whitish bloom (glaucous), having about the same number of leaflets as in the preceding species, of much the same shape, but smooth, conspicuously whitened beneath, and with fewer and coarser teeth. There is great difference in the size of the leaflets, in some forms they being 1 inch broad and 4 or 5 inches long, and in others only about half that size.

A variety occurs in Pennsylvania which has the leaflets deeply gashed, so as to be more or less twice pinnate. This species is very frequently dioecious: that is, some of the plants bear only male flowers and others only female flowers. The branches of the panicle and the drupes are somewhat hairy, but much less so than in *Rhus typhina*. This is a smaller shrub than the Staghorn sumac, usually growing from 3 to 10 feet high.

MARK.DEL.

NICHOLS.ENG.

RHUS GLABRA, L.

PLATE V.

RHUS COPALLINA L. Dwarf Sumac.

Young branches and leaf stalks finely downy, the branches frequently bearing numerous small resinous glands; the leaves 5 to 10 inches long, and composed of from 9 to 19 leaflets; in some forms the leaflets being large and few in number, and in others small and more numerous, varying from ovate to lanceolate and pointed, smooth and shining above, pubescent beneath, the margin generally entire. The two halves of the leaflet are usually unequal, one side extending farther down the mid-vein than the other. The petiole between the leaflets is winged with a narrow leaf-like margin. The panicles are sessile and spreading, the drupes red and sparingly hairy.

This species is usually from 3 to 6 or 8 feet.

MARX.DEL.

H.H.NICHOLS.ENG.

RHUS COPALLINA, L.

PLATE VI.

RHUS COTINUS L. Smoke-tree, Venetian Sumac.

This species belongs to a distinct section of the genus, and has by some botanists been placed in a separate genus. Its leaves are single instead of pinnate, as in the preceding species, the flowers in loose, open panicles, "followed rarely by little half heart-shaped fruits; usually most of the flowers are abortive, while their pedicels lengthen, branch, and bear long plumy hairs, making large or light feathery or cloud-like bunches, either greenish or tinged with red, which are very ornamental."

This species is quite frequently seen in cultivation, and is sometimes called smoke-bush or cloud-bush. It is a smooth shrub, usually 6 to 10 feet high, with thin, smooth, obovate leaves $1\frac{1}{2}$ to 3 inches long, with entire margins.

This species is a native of the south of Europe and Asia Minor.

A very similar species grows wild in some parts of Alabama, the *Rhus cotinoides*, Nutt.

PLATE VII.

RHUS CORIARIA L. European Sumac.

This species belongs to the same section as the preceding. The young branches and leaf stalks are rough-hairy; the leaves consist of from 11 to 15 leaflets, which are oblong or elliptical, 1 to 2 inches long, obtuse or obtusish, and coarsely toothed on the margin. The upper surface is rather rough, with short hairs; the lower surface also, at least on the nerves. The upper portion of the leaf stalk between the first and second pairs of leaflets is usually narrowly wing-margined. The color of the leaves is a light or grayish green. The flower panicles are more open than in the American species described, the flowers and drupes being also hairy.

In size it probably corresponds to our *R. typhina*, being a large bush, or becoming a small tree.

It is a native of the southern part of Europe and of Asia Minor.

W. ARX. DEL.

H. H. NICHOLS. ENG.

RHUS CORIARIA, L.

PLATE VIII.

RIHUS PENTAPHYLLA Desf. *Tezera Sumae*.

This species belongs to still another section of the genus, which is characterized by having dioecious flowers, 3 short but distinct styles, and a roundish tuberculate drupe, with compressed nutlet.

It has small palmately 3 to 5 foliate leaves, the leaflets sessile, linear-lanceolate, some of them broader and 3 toothed at the apex. The petiole or leaf-stalk is short and narrowly wing-margined. The leaves are from 1 to 2 inches long. The branches are short and tipped with spines.

The flowers are few, in short axillary racemes an inch or two long.

It is a native of Sicily and the Barbary States.

RHUS PENTAPHYLLUM, DESF.

H. H. NICHOLS, ENG.

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