GEOGRAPHICAL POSSIBILITIES OF CORK PRODUCTION IN THE UNITED STATES

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Scattered cork oaks growing in southern and southwestern states may prove to be the forerunners of an important cork production industry in the United States. The cork oak is indigenous to the Mediterranean region, the present center of world cork production, and trees from that region have been introduced into the United States. They represent various spasmodic attempts by the government, educational institutions, and interested individuals to establish the cork oak in this country.

Need for Cork

The need for cork in American industry was shown when the War Production Board listed it as one of fifteen critical materials essential to keeping the wheels of production turning. Even before the attack on Pearl Harbor, American supplies of cork were placed under strict regulation to channel them into defense and essential civilian usage. Cork gaskets and washers are "must" parts in keeping grease and oil at work lubricating machines. Among other uses of cork are insulation, corkboard, bomb parts, submarine linings, and life preservers.

> Cork is one of those versatile natural materials, like leather, that can do a lot of jobs well, and for which there is no single acceptable substitute . . . . The freeing of North Africa, and the bettering of the shipping situation to Mediterranean ports on the European side have relieved the cork situation considerably. Nevertheless, our recent unpleasant experience has taught us a sharp lesson and it will be far better, no matter what kind of improved world the peace may usher in, not to leave ourselves in a position to be caught in the same fix again.[1]

The exigencies of the early years of World War II plainly showed that cork production in the United States would be economically desirable if it could be proved geographically possible.

Present Distribution

The world cork supply comes from a region about the size of New Jersey. This region of intensive production lies within an area stretching for more than 1000 miles along the western part of the North African coast. In Europe the region stretches from the Landes area of France around the Iberian Peninsula in a narrow fringe along the Mediterranean to the toe of the Italian boot. Figure 1 shows the location of the Mediterranean region cork producing areas, for which the 1936 production statistics are given in table 1. This is the latest year for which full statistics for all countries are available. Incomplete figures for 1941 show small increases in production, but the only available postwar information indicates a small reduction following wartime peaks in Portugal and Spain.[2]

[1] Frank Thone, "Cork in Bottleneck," *Science News Letter,* XLIV (October 16, 1943), p. 247.

[2] Private communication with Spanish and Portuguese Embassies.

TABLE 1.—CORK OAK ACREAGE AND CORK PRODUCTION, MEDITERRANEAN REGION—1936[3]

Area		Country	Annual Production		
% of total	Acres (000's)		Short tons (000's)	% of total	Yield lb./acre
33.8	1,720	Portugal	130.0	46.2	151
12.2	622	Spain	66.0	23.1	212
21.6	1,100	Algeria	38.5	13.8	70
14.6	741	French Morocco	17.6	6.3	48
6.9	350	France, Corsica	13.2	4.8	75
4.9	247	Italy, Sardinia, Sicily	8.8	3.2	71
4.6	235	Tunisia	7.4	2.6	63
1.4	74	Spanish Morocco*	.....	.....	.....
100.0	5,089	Mediterranean Region	281.5	100.0	112

* Included as a potential producer.

GEOGRAPHIC FACTORS IN CORK GROWTH

The geographical possibilities of cork production in the United States are intimately related to temperature, rainfall, and soil. It was found that the cork oak grows: (1) equatorward of a composite line based on the 37° F. January and the 50° F. annual surface isotherms; (2) at annual surface temperatures between the limits of 50° F. and 70° F.; (3) under an annual rainfall between the limits of 10 and 60 inches; and (4) in a variety of soils ranging from semi-arid brown steppe soils to the moist tropical and subtropical red and yellow soils.

To translate these facts to the American scene, a map was constructed, showing the portion of the United States which met the above qualifications. Figure 2 shows this area, plus the areas too dry, too wet, or too hot. The unruled section of the United States lies beyond the poleward limit of growth for the cork oak.

[3] Victor A. Ryan, *Some Geographic and Economic Aspects of the Cork Oak* (Baltimore: Crown Cork & Seal Co., Inc., 1948), p. 19.

DISTRIBUTION OF AMERICAN CORK OAKS

With this picture of climatic and soil factors, our attention can be directed to the introduction and spread of the cork oak in the United States. Thomas Jefferson seems to have been the first American interested in the cork oak, but his attempts at establishing a cork production industry proved futile. The government was successful in 1858 and again in the eighties in having a few trees survive in the southeastern states and California. A substantial planting at Chico, California, was made in 1904, and state and local plantings have resulted in a distribution of cork oaks in the United States as shown in figure 3. It is interesting to note that they are not limited to the area usually classified as typically Mediterranean.

In 1940, over five tons of bark were stripped from California trees, marking the first time that cork oaks outside the Mediterranean region had been stripped of commercially marketable cork. Tests by the Crown Cork and Seal Company of Baltimore showed this bark to be equal

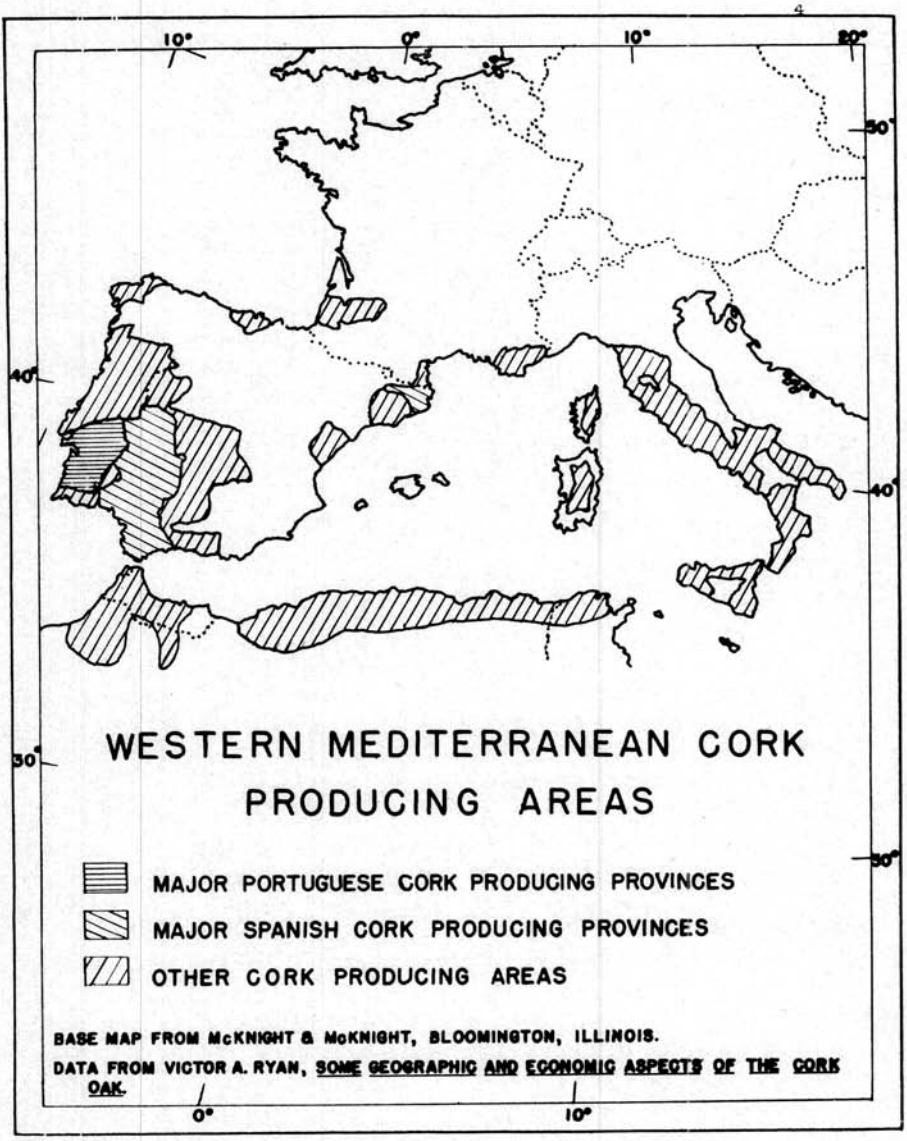
10°
0°
10°
20°
50°
40°
40°
30°
50°
WESTERN MEDITERRANEAN CORK
PRODUCING AREAS
MAJOR PORTUGUESE CORK PRODUCING PROVINCES
MAJOR SPANISH CORK PRODUCING PROVINCES
OTHER CORK PRODUCING AREAS
BASE MAP FROM McKNIGHT & McKNIGHT, BLOOMINGTON, ILLINOIS.
DATA FROM VICTOR A. RYAN, SOME GEOGRAPHIC AND ECONOMIC ASPECTS OF THE CORK OAK.
0°
10°

FIG. 1.

in quality to Old World cork. When considering that the United States imports some 150,000 tons of cork annually, it is readily seen that it was the *fact* rather than the *amount* of production that was of chief significance.

Production and Marketing Problems

In order to develop an overview of the industry, we may turn our attention to how the industry is conducted, what marketing practices may be developed, what competition in land use may be encountered, how competition by other products and by foreign countries is met, and what other problems cork producers may face.

Conduct of Industry

Cork production is a forest industry, the commercial product, cork, being the outer layer of the *Quercus suber* and *Quercus suber occidentalis* species of evergreen oak. The inner layer of bark, or phellogen, is alive and acts as a base on which each year the tree adds a new layer of cork. As these succeeding new inner layers are added, the outermost layers cease to be a living part of the tree and serve only as an insulating wrapper protecting the tree against loss of moisture and against the hot winds known as siroccos in the Western Mediterranean region.

It has apparently been known since Greco-Roman times that this outer bark could be removed without injury to the tree. The process of bark removal is known as stripping, and the same methods are being used in the United States that have been successful in Europe and North Africa. Two cuts are made around the tree with a sharp two-bladed hatchet, one cut at the ground level and the other just below the main branches (or at the height prescribed by law in most of the Old World cork-producing countries). Two vertical cuts following natural crevices in the bark are made, joining the horizontal cuts. The wedge-shaped hatchet handle is then inserted under the loosened bark and the whole sheet is pried off. The larger lower branches may be stripped in the same manner. Care must be taken not to injure the inner bark, and stripping should not be undertaken while a hot wind is blowing as the newly exposed phellogen will be dried out too rapidly. Nevertheless, the middle of the summer is the accepted stripping season.

The first stripping produces cork with a rough, grayish, uneven surface, known in the United States as "virgin" cork, suitable only for grinding for cork insulation and cork composition products. The second stripping is considerably better and, with the third stripping, fine quality cork is obtained. The trees are first stripped when 15-20 years of age and every 9-12 years thereafter during the productive life of about 100 years. The stripped bark is piled and allowed to dry a few days in the forest. It is then ready for boiling, a process which softens the cork and increases its elasticity so that it can be flattened for baling. Boiling removes dirt, sap, and tannic acid, and also softens the useless woody outer layer which is scraped off. The cork is dried, roughly sorted according to quality, and baled, ready to be taken from the immediate area of production.

Marketing Practices

American cork production has been so limited and so intimately

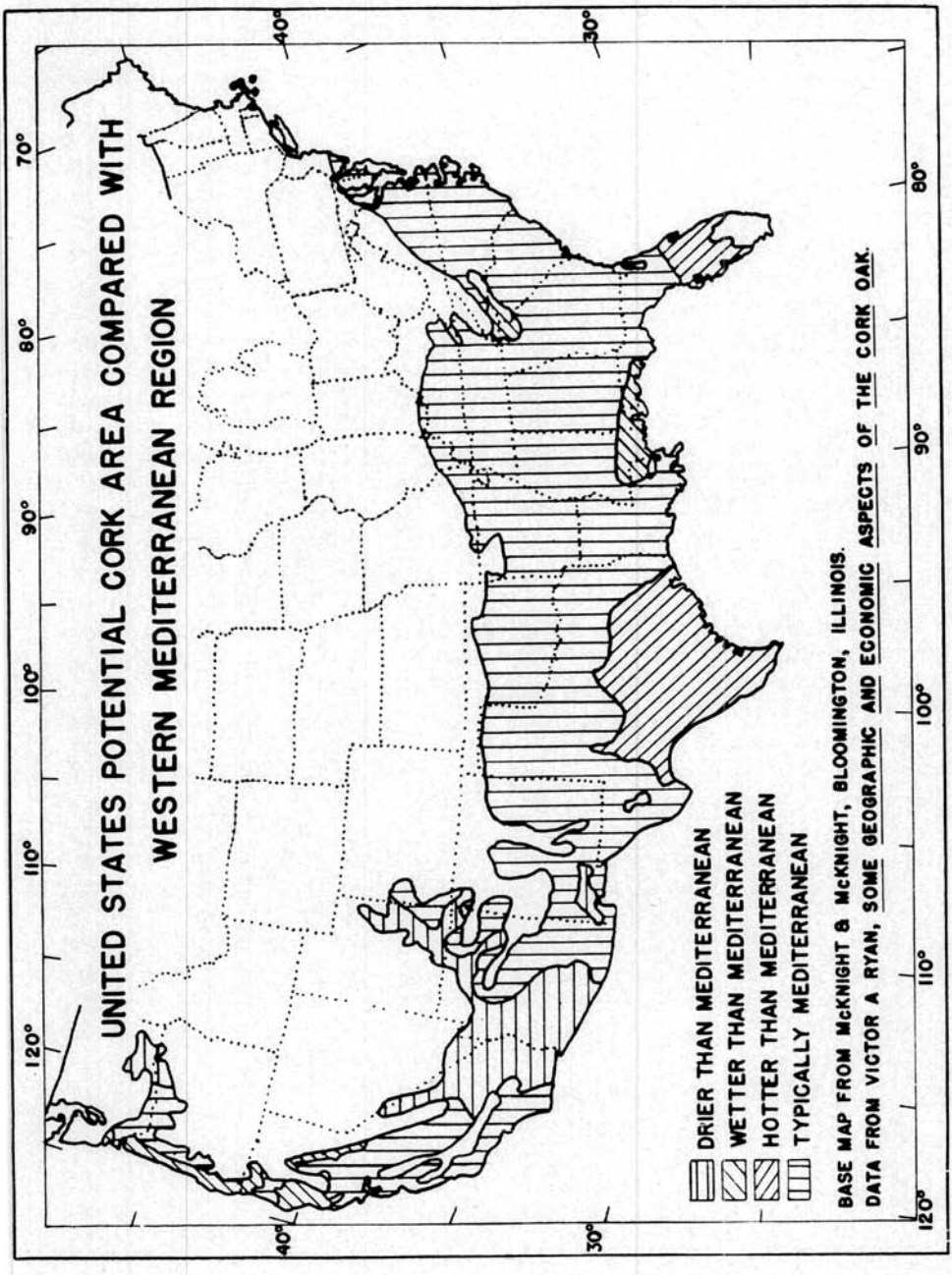
UNITED STATES POTENTIAL CORK AREA COMPARED WITH
WESTERN MEDITERRANEAN REGION
DRIER THAN MEDITERRANEAN
WETTER THAN MEDITERRANEAN
HOTTER THAN MEDITERRANEAN
TYPICALLY MEDITERRANEAN
BASE MAP FROM McKNIGHT & McKNIGHT, BLOOMINGTON, ILLINOIS.
DATA FROM VICTOR A RYAN, SOME GEOGRAPHIC AND ECONOMIC ASPECTS OF THE CORK OAK.
120°
110°
100°
90°
80°
70°
40°
30°

FIG. 2.

connected with the cork manufacturers that a definite code of competitive marketing practices has not as yet been established in the United States. In order to see what may develop here, an examination of two marketing systems employed in the Mediterranean region follows.

By one method the buyer purchases the cork bark in the forest before stripping. Before purchasing, the buyer sends a sampler through the forest who removes a small cylindrical section of cork from representative trees much as a fruit dealer plugs watermelons. These discs are taken to the buyer's office for careful examination before the buyer makes a bid to the forest owner.

The second method involves the sale of the stripped cork bark at public auctions. Some of these sales are handled in a manner similar to American auctions, while others have the unique feature of starting at a high figure, the auctioneer gradually lowering the asking price until a bid is received. The first lots of cork offered are generally small, and are frequently purchased by small operators before the large buyers come in and take everything.[4]

It should be re-emphasized that American cork production has been so limited to this time that neither the above nor other marketing practices have been developed in the United States.

Competition in Land Use

The study of soils revealed that Mediterranean cork was produced on relatively poor soils, the leached subtropical and tropical reds and yellows, and the brown steppe with its alkaline accumulations frequently forming a hardpan layer in the soil. In the United States, desert soils are supporting many mature cork oaks. Thus it is evident that the cork oak will thrive upon soils in which other vegetation is sparse. The United States contains hundreds of thousands of acres of the above mentioned soil types that could be planted to cork oak without crowding out or even infringing upon other economies. Many of the recent plantings in America have been made along fence rows, roadways, and in pasturelands. Few of the cork oak forests in the Mediterranean region are pure stands. The cork trees are often associated with olive trees, vineyards, or with other live oaks in pastures. Swine do very well feeding upon cork and other oak acorns. The pork of acorn-fed swine is said to have a very desirable piquant flavor. These concomitant land uses permit a sizable income per unit of land.

Competing Products

As mentioned in the opening paragraphs, no single acceptable substitute for cork has been found. Some of the materials used in place of cork are just as scarce as cork and are critically needed for other uses, as was found during World War II. Even for packing material, military technicians could find no successful substitute for cork. Materials such as pine needles and dried grasses were tried but none had all the qualities of cork—heat resistance, buoyancy, and strength. Barks of other trees, such as Pao Santo, Douglas fir, and other true firs have been studied and tested, but none has proved entirely satisfactory. To compete with natural cork in normal times, other barks must be cheaper, more readily accessible, or better than cork. At

[4] Arthur L. Faubel, *Cork and the American Cork Industry*, New York: Cork Institute of America, 1941, p. 16.

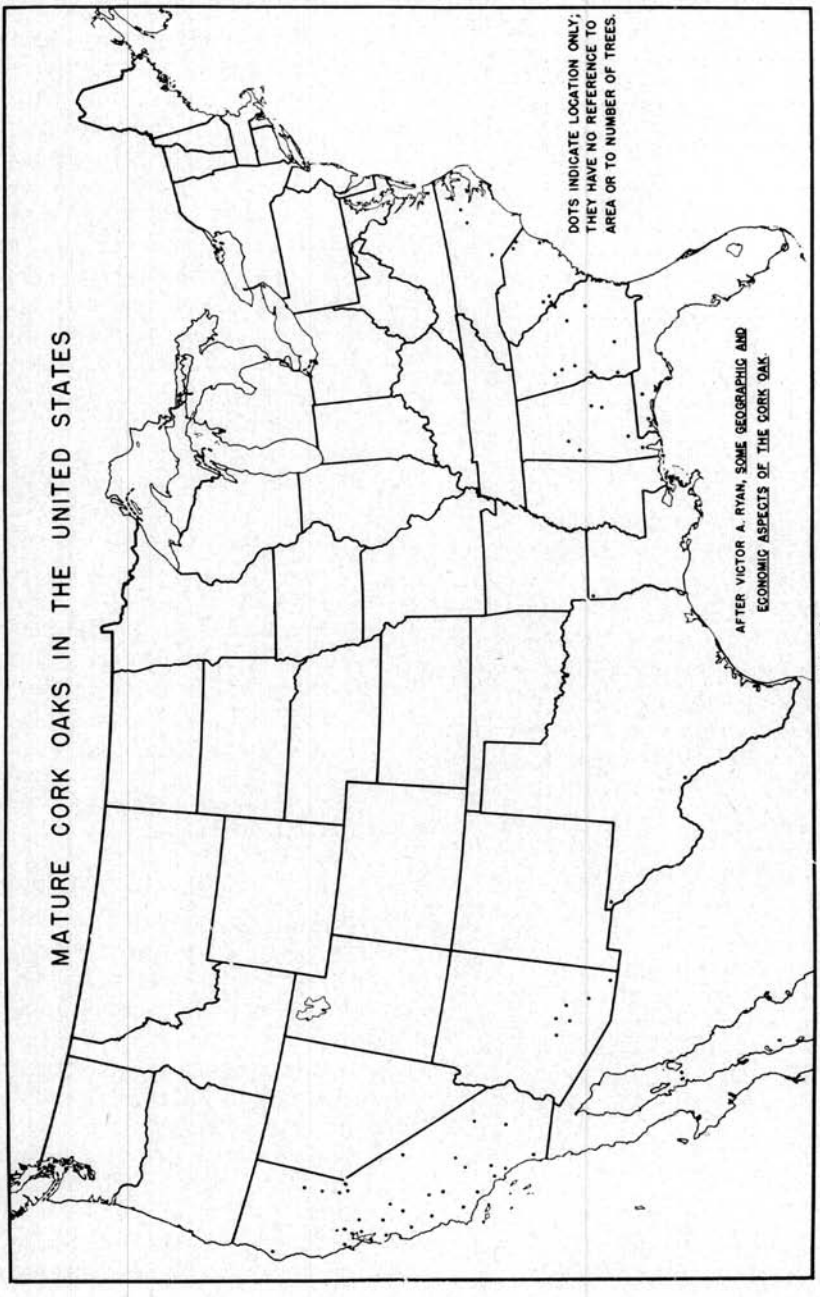
MATURE CORK OAKS IN THE UNITED STATES
DOTS INDICATE LOCATION ONLY; THEY HAVE NO REFERENCE TO AREA OR TO NUMBER OF TREES.
AFTER VICTOR A. RYAN, SOME GEOGRAPHIC AND ECONOMIC ASPECTS OF THE CORK OAK.

FIG. 3.

TABLE 2.—UNITED STATES IMPORTS OF UNMANUFACTURED CORK[5]
(Thousands of pounds)

Year	M Pounds
1927	223,091
1928	229,671
1929	267,598
1930	174,615
1931	135,401
1932	118,438
1933	187,184
1934	122,565
1935	153,076
1936	216,390
1937	322,898
1938	158,381
1939	227,575
1940	318,336
1944	189,629[a]
1945	265,453[b]

a From *Foreign Commerce and Navigation of the United States. Calendar Year 1944*, Vol. I, *Import and Export Statistics*, p. 199.
b *Ibid. Calendar Year 1945*, p. 133.

present they are none of these. Herman M. Kulman has patented a synthetic substitute made from peanut hulls.[6] It has been tested and judged acceptable for use in bottlecaps, gaskets, and wallboard, but is more expensive than natural cork.

The discussion of the other natural products and the synthetic material indicates that natural cork, to date, has been able to meet the competition of any and all substitute products. This is further borne out by the United States import statistics given in table 2. By 1945, United States imports of natural cork had again risen to a figure exceeded only by three peak pre-war years, indicating that very little, if any, of the United States demand is being filled by substitutes when natural cork is again available in large quantities.

FOREIGN COMPETITION

Since natural cork apparently can meet successfully the competition of substitute products, the competition faced by American producers will come from cork production abroad. There are at least two ways to meet this competition: one, with the aid of a protective tariff; and, two, by actually equalling or under-bidding the prices of Old World cork at the factory door. At present, unmanufactured cork is on our free trade list, and a protective duty seems unlikely and probably undesirable at this time. Victor A. Ryan's study showed that in terms of income per acre of cork oaks, based on actual American production costs and present Mediterranean prices, the American grower can compete with the Old World producer and deliver bark at the American factory door at a lower figure.[7] It would seem that a scientifically based American cork production industry should easily survive the competition of the Old World cork production industry as the latter is now being conducted.

OTHER PROBLEMS

Other problems that American cork producers must face are cork oak diseases and insect pests. As yet, only the cork oak cynipid has given trouble. This small insect has infested some California trees, killing smaller twigs, and reducing the vitality and bark growth in some instances.[8]

Another problem involves the rate of growth of the cork bark. Although it is known that xerophytes have no definite moisture requirements, being able to tolerate more moisture while continuing to grow slowly, there is some acceleration in the growth rate of cork due to in-

[5] Mary V. Day, "Cork Goes to War," *Foreign Commerce Weekly*, pp. 54, 58.
[6] "Peanut Hull Cork," *Business Week* (November 27, 1943), pp. 54, 58.
[7] Ryan, *op. cit.*, pp. 85-87.
[8] E. O. Essig, "The Cork Oak Cynipid in California," *Journal of Economic Entomology*, XXXVI (February, 1943), pp. 123-124.

creased precipitation. Since more rapid growth creates coarser structure and less valuable cork, the regions of the United States in the potential cork area wetter than the Mediterranean region are at a disadvantage compared to the drier American areas. They will lose more in price per ton of cork due to poorer quality than they will gain in weight by increased growth rates. On the other hand, trees in the wetter areas are larger producers of acorns, so important for planting in the establishment of any future cork production industry. Cultivation of the cork oak may increase the growth rate and imposes a problem as to the extent of cultivation economically desirable.

Conclusions

The United States has had a constant and fairly consistent need for cork, an especially critical essential material in wartime. The United States has within its borders vast areas having climate and soil characteristics similar to the present producing areas in the Mediterranean region; also it has other climatic regions in which cork trees are now growing. United States cork has been found equal in quality to Mediterranean cork. The estimated returns of American cork production conducted scientifically would seem to compare very favorably with Old World cork production income on an annual income per acre basis. A cork production industry in the United States could be established in addition to our present activities, with little or no infringement upon present use of productive lands; and there seem to be no technical problems or difficulties of consequence.

While the above facts may lead one to conclude that the establishment of a sizable cork production industry in the United States is inevitable, further studies will be necessary to test the application of theory to practice, and to interpret the effects that economic and political developments in the world have upon cork production. At this time we can only conclude that the United States seems to have the geographical possibilities for cork production, and reiterate the statement of J. Russell Smith, made in 1929, that "apparently there is no reason except inertia why we should not in time have an extensive cork (production) industry in the United States."[9]

[9] J. Russell Smith, *Tree Crops—A Permanent Agriculture.* (New York: Harcourt, Brace and Co., Inc., 1929), p. 139.

BIBLIOGRAPHY

Blair, Thomas A. *Climatology.* New York: Prentice-Hall, Inc., 1942.

Faubel, Arthur L. *Cork and the American Cork Industry.* New York: Cork Institute of America, 1941.

Finch, V. C., Trewartha, G. T., and Shearer, M. H. *The Earth and its Resources.* New York: McGraw-Hill Book Co., Inc., 1941.

Ryan, Victor A. *Some Geographic and Economic Aspects of the Cork Oak.* Baltimore: Crown Cork and Seal Co., Inc., 1948.

Smith, J. Russell. *Tree Crops — A Permanent Agriculture.* New York: Harcourt, Brace and Co., 1929.

Public Documents

U. S. Department of Agriculture. *Yearbook of Agriculture. 1941. Climate and Man.* Washington: Government Printing Office, 1941.

U. S. Department of Commerce. *Foreign Commerce and Navigation of the United States. Calendar Year 1944.* Vol. I. *United States Import and Export Statistics.* Washington: Government Printing Office, 1946.

U. S. Department of Commerce. *Foreign Commerce and Navigation of the United States. Calendar Year 1945.* Vol. I. *United States Import and Ex-*

port Statistics. Washington: Government Printing Office, 1948.

ARTICLES

BLANCHARD, W. O., "The Cork Oak," *Journal of Geography*, XXV (October, 1926), pp. 241-249.

"Cork from Fir," *Business Week*, November 7, 1947. pp. 78-79.

COOKE, GILES B., "Cork Culture in the United States," *Scientific Monthly*, LVIII (May, 1944), pp. 357-364.

————————, "Growing Cork Oak in the South," *American Forests*, IL (December, 1943), pp. 582-584.

————————, "Progress in Cork Culture in the United States," *Scientific Monthly*, LXIV (February, 1947), pp. 117-122.

COOKE, GILES B., and SCHMIDT, CLIFTON F., Jr. "Thomas Jefferson, Planter of Cork," *The Crown*, August, 1943.

CRONE, DONALD R., "Cork Substitute from Brazil?" *Foreign Commerce Weekly*, VII (May 30, 1942), pp. 6-7, 31.

DAY, MARY V., "Cork Goes to War," *Foreign Commerce Weekly*, V (October 18, 1941), pp. 4-5.

Encyclopaedia Britannica. 1946. Vol. VI. Article, "Cork."

Encyclopedia Americana. 1948. Vol. VII. Article, "Cork."

ESSIG, E. O., "The Cork Oak Cynipid in California," *Journal of Economic Entomology*, XXXVI (February, 1943), pp. 123-124.

GREENAN, GEORGE D., "Cork Tree from Spain," *Nature Magazine*, XLI (April, 1948), pp. 212-213, 218.

"Peanut Hull Cork," *Business Week*, November 27, 1943, pp. 54, 59.

RINGLE, RUTH, "Cork Oak—Naturalized American," *American Forests*, XLVIII (April, 1942), pp. 161-163, 186-187.

THONE, FRANK, "Cork in Bottleneck," *Science News Letter*, XLIV (October 16, 1943), pp. 247, 250.

PAMPHLETS

COOKE, GILES B., *The Planting and Growing of Cork Oak Trees in the United States*. Baltimore: Crown Cork & Seal Co., Inc., 1947.