Industrial Development Subsidiary Agreement

MARKET STUDY FOR B. C. CEDAR FOLIAGE OIL

MAY 1982

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Regional Economic Expansion
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MARKET STUDY FOR B. C. CEDAR FOLIAGE OIL

MAY 1982

Prepared For:

THE SCIENCE COUNCIL OF BRITISH COLUMBIA

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THE RESPONSIBILITY FOR THE CONTENT OF THIS REPORT IS THE CONSULTANT'S ALONE, AND THE CONCLUSIONS REACHED HEREIN DO NOT NECESSARILY REFLECT THE OPINIONS OF THOSE WHO ASSISTED DURING THE COURSE OF THIS INVESTIGATION OR THE FEDERAL AND PROVINCIAL GOVERNMENTS WHICH FUNDED THE STUDY.

Executive Summary

1. Introduction

As part of a detailed technical and economic analysis of cedar leaf oil production, the Science Council of British Columbia awarded a contract to Forintek Canada Corp. and H.N. Halvorson Consultants Ltd. to undertake a market survey for western red cedar leaf oil. The survey was funded by the Research Program of the Canada-British Columbia Industrial Development Subsidiary Agreement.

The study objectives (1) were:

a. to determine appropriate market values and the scale of the potential market for cedar foliage oil.
b. to identify the market potential for the chemical derivatives of cedar foliage oil.
c. to provide a brief analysis of the market for other coniferous foliage oils.

The consultants were instructed to contact potential end-users with a mail questionnaire and to follow-up user interest in a field trip.

In the late 1960's, MacMillan Bloedel Ltd. undertook an extensive evaluation of the production and marketing of cedar leaf oil. Some 12 reports were written over the period May 1968 to August 1970 but the project was then terminated.

The Science Council of B.C., since 1978, has spent approximately $600,000 funding research into the commercial feasibility of cedar leaf oil as a new industry for the province. The largest part of this expenditure has been to support basic research by Dr. J. Kutney, UBC Department of Chemistry. His group has worked on the chemical synthesis of derivatives of α- thujone, the dominant chemical in the oil, for possible use in the perfumery, agricultural and pharmaceutical industries. Alan Moss and Associates Ltd., Kelowna, B.C., on a Science Council grant, studied the methods and preliminary economics of raw materials collection and production of cedar leaf oil in a pilot plant situation. In addition to this work funded by the Science Council, Forintek Canada Corp. examined the use of distillation residue from a cedar leaf oil facility for cattle and poultry feed and as a plywood glue extender.

Work by Alan Moss and Associates estimated that B.C. cedar leaf oil would require a selling price in the range of U.S. $21 to $23 per lb. from facilities making 30,000 to 50,000 lb. per year. Such facilities were estimated to cost from $870,000 to $1,400,000 respectively. B.C. forests could probably support 20 such facilities for a total B.C. production potential, on a sustained basis, of 2 million lb. per year of cedar leaf oil.

A cedar leaf oil industry exists in Ontario, Quebec and the New England states based on eastern white cedar (Thuja occidentalis). An essential part of the market study was to examine the structure of this industry and the competitiveness of B.C. oil.

2. Summary and Conclusion

A questionnaire was sent to approximately 300 companies active in the essential oil industry - producers, users and brokers. Some 22 expressed a degree of interest in cedar leaf oil and/or thujone and its derivatives. These were contacted by telephone and/or visited on a field trip.

After the interviews, four companies were still somewhat interested in B.C. cedar leaf oil (perfumery applications) and two in thujone from B.C. oil. However, price was a critical factor to their continued interest.

A plant constructed in B.C. to produce cedar leaf oil might possibly achieve sales levels of 2000-5000 lb. per year in its initial years. Co-production of other needle oils might add 1000-2000 lb. per year. Any growth in output would depend on the results of basic research and development programmes requiring at least 5 to 10 years before commercialization might occur. It is doubtful output would exceed 10,000 lb. per year, in the foreseeable future. Any market penetration for the oil would be primarily at the expense of existing eastern Canadian producers of cedar leaf oil. To market its production, a B.C. operation would have to sell cedar leaf oil at a delivered price 10 to 15% below that of eastern cedar leaf oil or for approximately U.S. $8.50-11.50 per lb., delivered New York. Also, to gain a significant market share, a B.C. plant would have to capture a portion of Richardson-Vicks' purchases. They are the world's largest user representing well over 50% of the total demand.

The sale of B.C. cedar leaf oil as a source of thujone for chemical feedstock is unlikely. For volume applications, thujone would have to sell in the U.S. $2-$5 per lb. range. For high cost applications (none now exist) volumes would be small and likely susceptible to replacement by thujone from other sources.

There have been numerous attempts, mostly in Quebec, to convert cedar leaf oil production from a "cottage industry" to a mechanized, modern one. All attempts have failed. To compete, a B.C. facility would have to be the "cottage industry" type with a capital cost in U.S. $10,000 to $20,000 per installation range. Even on this basis, government subsidy would likely still be required to cover the high cost of harvesting cedar brush.

3. Recommendations

1. All work on the concept of a B.C. facility to produce cedar leaf oil should be terminated.

2. Research work on the chemistry of thujone should only be continued with the full awareness that commercialization is years away and that western red cedar leaf oil may not be the most economic source of thujone.

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A. Background Information Used in the Study

1. MacMillan Bloedel Studies*

Some years ago, MacMillan Bloedel (M & B) undertook an extensive evaluation of markets for leaf oils, primarily western red cedar. Cedar wood oil was also surveyed, but to a lesser extent. In 1968, M & B identified the world market for eastern cedar leaf oil as being 120,000 lb. per year (300 drums) worth approximately $600,000-700,000 per year (quoted price $5.25-5.50 per lb. in drum quantities). The company estimated production of 80,000 lb. per year was feasible. This conclusion was based on discussion with 18 companies (brokers, traders and users). Of these, the following expressed direct interest in B.C. cedar leaf oil:

The John D. Walsh Co. Inc., New York	(trader)
Henly and Co., New York	(trader)
J. Manheimer and Co., New York	(trader)
Berje Chemical Products Inc., New York	(trader)
International Flavors and Fragrances, New Jersey	(consumer)
Ungerer and Co., New York	(trader, consumer)

With the exception of International Flavors and Fragrances, apparently none of the major users of essential oils expressed interest.

M & B decided to contract with J. Manheimer and Co. to develop the market using samples generated in a M & B pilot plant. Manheimer was to be the sales agent for a 5% commission on the wholesale price. Because the preliminary assessment indicated that western cedar leaf oil had an advantage over eastern oil for use in soaps, the strategy was to concentrate on the larger soap manufacturers. M & B concluded that the concentration of α - fenchene (0.8%), ℓ - fenchone (14%), and camphor (1.9%) in eastern oil eliminated the oil from use in soaps and other large volume uses. These three chemicals were present in M & B's oil at concentrations all below 0.1%. While Manheimer was concentrating on the soap manufacturers, pilot plant production was also to be used to provide samples for evaluation by other potential users in the U.S.A., Canada and Europe. When the pilot plant had provided sufficient experience on quality and costs had been established so that firm prices could be quoted, trial orders were to be supplied from accumulated stock and plant capacity increased as market developed. The strategy was to concentrate first on western red cedar and,

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* Permission has been obtained from M & B Research to summarize the results of their work.

once its volume had built to a satisfactory level, to consider hemlock, balsam and fir oils.

The pilot plant was run in 1969 for 6 weeks producing 300 lb. of cedar oil. The yield of oil was 1.1% of oven dry charge and the oil averaged 82.1% thujone. Subsequent work showed that twigs and needles from young trees (less than 4" diameter trunks) gave a yield of 1.8% compared to 0.7% for twigs and needles from mature trees (over 24" diameter). The yields of oil per acre for young trees was 8.6 lb., compared to 3 to 6 lb. for mature trees. If heartwood were included in the charge, (15-26% of total), the odor was radically different and the thujone content of the oil was 65-70%, compared to 82% for oil from twigs and needles. Based on the pilot and laboratory results and field surveys of actual forest sites, four producing facilities were costed, all on Vancouver Island. The results obtained are summarized below*:

	#1	#2	#3	#4
Oil production - lb./year	240,000	130,000	60,000	50,000
Capital investment	$310,000	$310,000	$240,000	$260,000
Minimum selling price - $/lb.**	6.35	4.30	7.55	10.30

The major costs were harvesting and trucking brush to the distillation plant:

	Share of Total Selling Price %	
Harvesting	49 - 54	66 - 87
Trucking	17 - 33	
Distillation	12 - 22	
Profit	3 - 8	

M & B examined thujone derivatives and concluded the ones with the most potential were thujyl alcohol and its esters, and also d-carvone and carvacrol.

The last reported work by M & B was in November, 1970. All work was stopped about this time, reportedly because of budget constraints. J. Manheimer reports (2) that after the initial contacts by M & B, they heard no more about B.C. oil production until contacted during this present study.

* Costs differ because of location, transportation and oil yields.

** FOB New York price required to cover all operating and depreciation costs and an acceptable profit to M & B.

2. Alan Moss & Associates Ltd.

Before the market survey was started, Alan Moss & Associates provided a preliminary assessment of the cost of producing B.C. cedar leaf oil. These costs were for use in discussions with the essential oil industry (3,4). The figures were provided on the basis that they were preliminary and subject to change in the final report then under preparation by the company for the Science Council.

Based on a scheme that involved collecting cedar foliage from a tree thinning operation and trucking it to a nearby distillation plant, an approximate selling price of U.S. $22-23 per lb. appeared to be required. Such a facility would cost about $500,000 and produce approximately 100,000 lb. per year of oil. The company estimated the total B.C. forest could support roughly 20 such plants on a sustained basis for an eventual production rate of approximately 2 million lb. per year.

In its final report to the Science Council (5) dated September, 1981, Alan Moss & Associates estimated the required selling price of cedar leaf oil from two facilities, one in the Slocan area and the other near Revelstoke, as follows:

Location	Annual Production lb. per year	Capital Cost Can. $*	Required Selling Prices U.S. $ per lb.**
Revelstoke	50,000	1,403,750	21
Slocan	30,000	874,000	23

The most expensive activity in the Moss analysis is the harvesting of the foliage. This was also the case for M & B a decade earlier. The M & B and Moss figures for the percentage distribution of operating costs (exclusive of capital depreciation, profit and freight to market) compare as overleaf:

* Including working capital of $162,000 and $110,000 for Revelstoke and Slocan, respectively.

** Including return on investment of U.S. $7 per lb. in both cases, and assuming an exchange rate of U.S. $1 = Can. $1.18.

	Share of Direct Operating Costs	
	M & B Estimates	Alan Moss Estimates
Harvesting	57%	59%
Trucking	37	18
Distillation	6	23
	100%	100%

As is shown later in the report, eastern cedar leaf oil producers pay about $90 per ton for cedar brush delivered to their distillation plant, or about 65% of the selling price to Richardson-Vicks, the largest consumer.

3. Dr. J. Kutney

Dr. Kutney provided information on the work his group is doing on chemical synthesis of thujone derivatives. This was included in a handout prepared for distribution to companies interviewed on the field trip. A copy of this handout is presented in Appendix A.

In addition, Dr. Kutney recommended that specific attention be given to the following companies because they had expressed directly to him interest in B.C. cedar leaf oil and its components (6):

1. Ciba-Geigy - interested in thujone derivatives
2. Givaudan - interested in thujone
3. Firmenich - interested in the oil itself.

B. Procedure

1. Questionnaire

A questionnaire was prepared and sent to important companies in the world's essential oil industry - producers, brokers/traders and consumers.

The questionnaire was accompanied by a letter explaining the purpose of the market survey and providing a history of the project with respect not only to production of cedar leaf oil but also to Dr. Kutney's work with thujone derivatives.

The questionnaire was directed at soliciting interest in cedar leaf oil itself, as well as in thujone as a chemical feedstock. In addition, possible interest in the other coniferous oils that might be produced in B.C. was solicited.

A copy of the questionnaire, accompanying letter and attachments describing cedar leaf oil and other B.C. coniferous oils is given in Appendix B.

The names of companies chosen for contact were obtained from membership lists for essential oil and perfume trade associations in the U.S.A. and Western Europe. In addition, Canadian Consulates and Trade Commissioners in all the important Western European countries and the Far East were solicited for names of companies to contact. Also, any company MacMillan Bloedel had contacted in its survey of 10 years ago was included. In addition, those companies with which Dr. Kutney had had contact, as well as the major world chemical manufacturing companies were included in the surveys. Appendix C lists the Canadian Trade Commissioners and industry associations contacted.

In addition, Mitsui and Co., (Canada) Ltd, agreed to undertake a comprehensive survey of the Japanese and Far Eastern markets.

All the industries that were judged to have any possible interest in cedar oil were included: aroma chemicals, perfumes/fragrances, insecticides, fungicides, soaps, surfactants (flotation reagents), pharmaceuticals, patent medicines and general organic chemicals.

In total, the questionnaire was sent to 304 companies: 207 in the U.S., 73 in Western Europe and 24 in Canada. The list of companies, their addresses and a brief summary of responses from each company is presented in Appendix D.

Some delay was experienced with the questionnaire because of the Canadian postal strike. As an expedient, a mail drop in Washington State was used for returns.

2. Field Trip

Initially, the intention was to follow-up the questionnaire with a field trip to Eastern U.S.A., Eastern Canada and Europe. The results from the questionnaire indicated that a field trip of this magnitude was not justified. After consultation with the Science Council, it was agreed a telephone sampling of important U.S. companies would be done and, if judged to be warranted, a limited field trip would be undertaken. As a result, a week long visit to traders and users in the New York area was made in late September, 1981.

File notes were written summarizing all significant discussions (telephone and actual meetings). These are on file at the Science Council.

C. Description of the World Essential Oil Industry

1. General

Cedar leaf oil belongs to a large group of plant substances referred to as essential oils. The term "essential oil" is derived from the age-old belief that the fragrance of a substance contains its very essence.

Essential oils, generally speaking, are volatile substances obtained from plant material which impart to the material their characteristic odor or flavor. They are removed from the raw material by either expression (squeezing) or distillation.

It is not yet fully understood what function these oily, non-water soluble, fragrant substances fulfill in the life process of the plant. They do not participate in the plant's metabolism. It is generally accepted that, in many plants, the presence of essential oils presents a certain protection against animal predators which are repelled by the strong taste which the oils impart to the foliage, wood and bark.

The essential oil industry is an ancient one. The use of essential oils must have preceded the development of writing, since many of our earliest records refer to them as already well-known and highly-prized commodities. The spice trade was the source of wealth of Alexandria, and the search for spices was the impetus behind the voyages of Columbus and other European explorers.

In ancient times, the spices and their essential oils were important commodities used in perfumes, religious offerings, medicines, preservatives and flavors. Today, uses of essential oils are much the same, although now perfume and flavor applications predominate.

While wild plants still are the source of most essential oils, many oils, especially the large volume ones, are recovered from cultivated plants grown on mechanized farms.

2. Distribution System

Marketing of essential oils, worldwide, is still in the hands of a few specialty brokers and trading houses. These companies either sell oil on a commission basis (as brokers) for producers, or actually purchase in quantity, warehouse and resell in smaller lots (as traders). A few of the larger trading houses process essential oils and market the resulting major components. Some also formulate perfume and flavor recipes. Some of these, in turn, have evolved into perfumery/flavor manufacturers who buy essential oils in quantity to obtain low prices for their captive use, and resell that oil which is in excess of their requirements.

The net result is that companies involved in the essential oil business are very specialized, relatively few in number and generally trade on a worldwide basis. The major chemical companies, e.g., ICI,

Dupont, are not involved in the essential oil industry, except, perhaps, through having purchased ownership of an essential oil broker/trader.

3. Statistics

The essential oil industry covers a wide variety of oils from common low cost materials, such as orange oil, in the $0.50 per lb. price range, to rose oil in excess of $850.00 per lb. Price lists obtained from The John D. Walsh Co. Inc., and E.L. Scott and Co. Inc. are given in Appendix E. These present the wide range of essential oils traded.

Statistics on the industry are poor. The only available information of note is a U.S. Department of Agriculture publication "Essential Oils" (7). It is issued annually, usually in April. This publication lists quantities and values of U.S. imports and exports of the major essential oils by country, but no production data are presented. Production data were not available through neither Canadian Embassy offices nor industry trade associations.

If it is assumed that the U.S. is such a dominant factor in the industry that its sources of supply and share of the trade are representative of the whole, the U.S. import/export data can be used to create a reasonable picture of world industry. This assumption seems reasonably valid since it is reported that the U.S. accounts for about half the world's consumption (40).

Table 1 provides a list of essential oils and their unit costs. Some 40 materials, ranging in price from U.S. $0.46 to $866.00 per lb., are traded in reasonable quantity. As would be expected, the small volume commodities generally command the highest prices. This is demonstrated in Figure 1. Major exceptions are the high volume oils used in consumer flavorings: lemon, spearmint, peppermint and lime. The U.S. dominates the production of the first three; Mexico, the fourth (lime).

Figure 1 demonstrates that cedar leaf oil is one of the smaller volume and higher priced essential oils.

Table 2 attempts to show the major producing countries, again using U.S. import data. The underdeveloped nations are important producers. This is a most significant factor as these countries require hard currency and tend to undercut prices to assure sales.

TABLE 1: The Common Essential Oils and Their Unit Costs

	1980 U.S. imports 1,000 lbs.	FOB value at origin U.S. $/lb.
Almond oil	128.7	1.98
Anise oil	114.9	7.84
Bergamot	75.7	33.35
Camphor	179.5	1.21
Caraway	14.4	23.96
Cassia	197.0	33.58
Cedar leaf	21.0	17.98
Cedarwood	527.0	0.75
Cinnamon	28.7	5.24
Citronella	1127.8	3.64
Citrus, other	30.3	11.70
Clove	1869.8	2.01
Cornmint	584.4	3.52
Eucalyptus	781.3	1.49
Geranium	157.6	24.84
Grapefruit	39.2	1.15
Lavender	202.2	12.94
Lemon	1895.9	14.58
Lemongrass	175.8	3.64
Lignaloe (Bois de rose oil)	321.6	5.67
Lime	1412.0	13.20
Neroli (Orange flower)	0.7	285.70
Nutmeg	178.7	7.88
Onion and Garlic	16.3	7.77
Orange	4965.0	0.46
Origanum	7.1	16.60
Orris	0.9	509.60
Palmarosa	22.8	11.69
Patchouli	621.5	15.70
Peppermint	10.1	15.17
Petitgrain	466.2	8.69
Pine	782.2	3.64
Pineneedle	37.2	7.90
Rose (attar of roses)	1.6	865.88
Rosemary	122.5	6.37
Sandalwood	53.3	38.40
Sassafras	501.8	1.60
Spearmint	16.9	5.23
Thyme	19.0	15.94
Vetiver	253.7	18.17
Ylang Ylang	94.7	26.95
Other	2765.0	7.20
Total	20821.9	
U.S. Exports		
Cedarwood, clove, nutmeg	724.0	3.72
Lemon	1054.2	10.99
Orange	7901.0	0.72
Peppermint	2205.3	11.21
Spearmint	1183.4	11.39
Other	5684.7	4.71
Total	18752.6	

FIGURE 1: Comparison of U.S. Trade Volumes of Essential Oils with Selling Prices

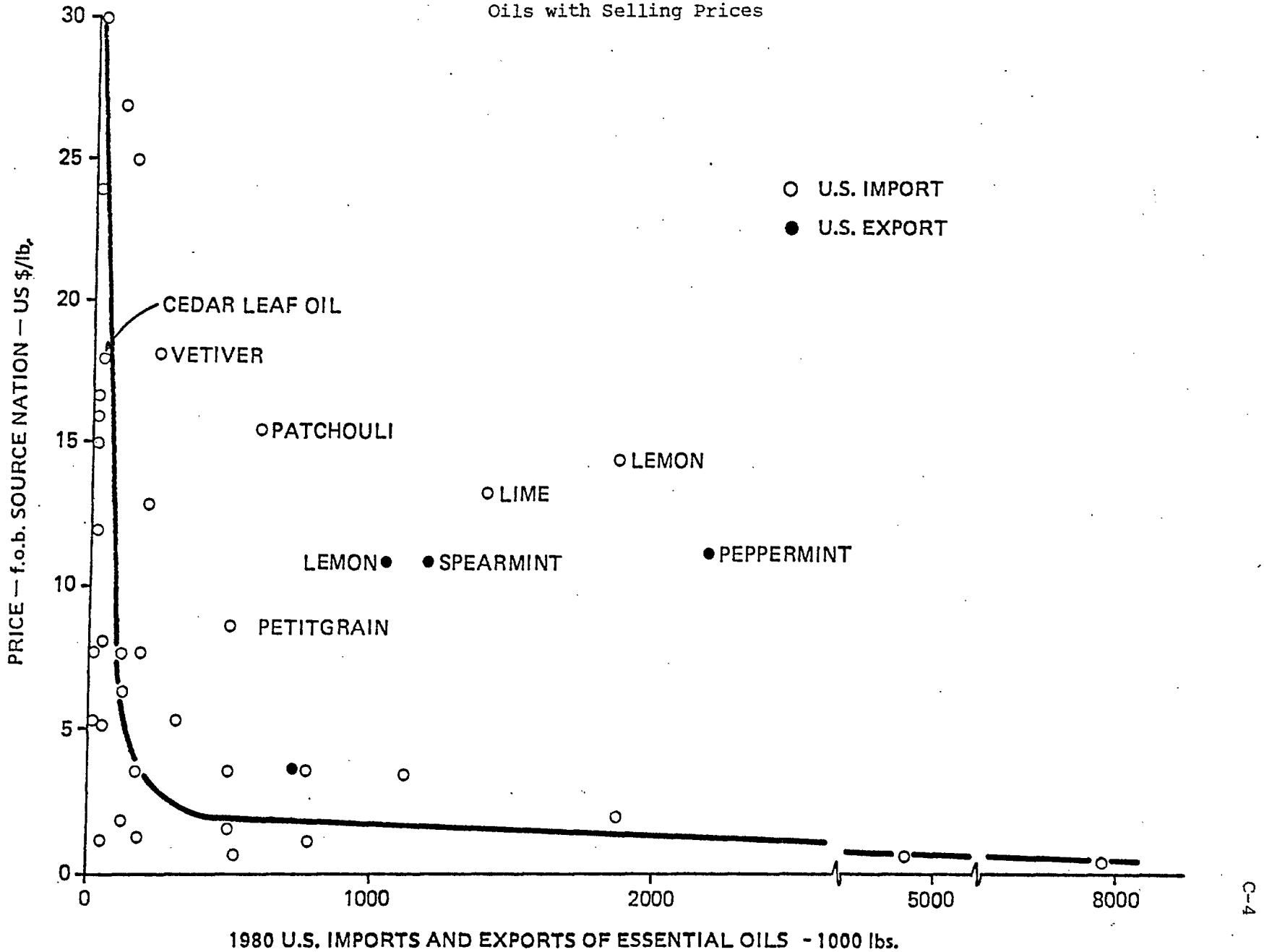

TABLE 2: U.S. Imports/Exports of Essential Oils (1980)

A. IMPORTS

Source	Value 1000 $U.S.	Share %	Type of oil %
Argentina (82%) and Paraguay (18%)	23,219	16.0	79 lemon, 14 petitgrain, 2 citronella, 5 other
France	19,951	13.7	11 ylang, 8 lavender, 7 geranium, 5 bergamot, 69 other
China	18, 762(1)	12.9	30 menthol, 26 cassia, 9 patchouli, 6 citronella, 4 cornmint, 4 anise, 4 eucalyptus 17 other.
South East Asia(2)	16,531	11.4	49 patchouli, 16 clove, 8 nutmeg, 7 sandalwood, 7 vetiver, 6 citronella, 1 cloves, 7 other
Brazil (92%), Peru (7%) Bolivia (1%)	15,557	10.7	39 menthol, 13 lime, 11 rose, 11 lemon, 9 orange, 6 cornmint 5 sassafras, 1 bergamot, 5 other
Mexico	12,872	8.9	93 lime, 5 orange, 2 pine
Southern Eupope(3)	8,737	6.0	50 lemon, 14 bergamot, 8 lavender, 4 rosemary, 3 onion, 3 thyme, 3 eucalyptus, 15 other
Caribbean(4)	8,703	6.0	35 lime, 30 vetiver, 5 lemongrass, 4 orange, 4 citronella, 22 other
Far East excl. China(7)	5,325	3.7	32 cassia, 34 menthol, 23 citronella, 4 camphor, 7 other
European Perfume Manufacturing Countries(5)	4,492	3.1	15 lemon, 14 lime, 9 rose, 7 orange, 5 lavender, 4 caraway, 46 other
North Africa and Eastern Mediterranean(6)	3,588	2.5	20 lemon, 24 rosemary, 19 geranium, 4 lavender, 4 onion, 29 other
Western Indian Ocean(10)	2,315	1.6	43 geranium, 34 cloves, 3 ylang, 13 vetiver, 7 other
India	1,550(9)	1.1	51 sandalwood, 11 palmarosa, 5 lemongrass, 33 other
Australia (92%) and New Zealand (8%)	1,067	0.7	81 lemon, 4 cloves, 1 eucalyptus, 14 other
Other Continental Europe(8)	917	0.6	17 rose, 20 caraway, 14 lavender, 49 other
Ivory Coast	781	0.5	65 lime, 29 lemon, 6 bergamot,
Canada	745	0.5	50 cedar leaf, 17 pineneedle, 15 lemon, 18 other
S. Africa	181	0.1	58 geranium, 24 eucalyptus, 13 vetiver, 5 other
	145,293	100.0	

B. EXPORTS

All Countries	85,021		7 orange, 29 peppermint, 16 spearmint, 14 lemon, 3 cedarwood, 31 other

TABLE 2: Footnotes

1. Includes $2,000 or 0.01% from Korea.

2. 94% Indonesia, 3% Singapore, 2% Sri Lanka, 1% Malaysia, 0.01% Philippines.

3. 68% Italy, 29% Spain, 3% Portugal.

4. 59% Haiti, 13% Jamaica, 12% Guatemala, 7% Trinidad, 6% Dominican Republic, 1% Bahamas, and 2% Belize, Guyana, Leeward Islands, Venezuela, and Honduras.

5. 47% U.K., 44% Switzerland, 3% Netherlands, 6% W. Germany; excluding France.

6. 32% Egypt, 26% Tunisia, 21% Yugoslavia, 8% Turkey, 7% Israel, 4% Algeria and 2% Cyprus, Lebanon, and Morocco.

7. 58% Japan, 35% Taiwan, 6% Hong Kong, 1% Macao.

8. 32% Bulgaria, 27% Austria, 22% Poland, 17% U.S.S.R., 1% Belgium, and 1% Hungary, E. Germany, Denmark and Ireland.

9. Includes $1,000 or 0.06% from Pakistan.

10. 63% Madagascar, 23% Reunion, 11% Comores, 2% Tanzania, 1% Seychelles.

4. Canada's Role

Canada is a small factor in the overall essential oil industry, accounting for less than 1% of U.S. imports and, therefore, probably even less of total world trade. Half of the Canadian exports to the U.S. in 1980 were cedar leaf oil:

Oil	1980 U.S. Import from Canada	
	lb.	U.S. $
cedar leaf	20, 815	371,900
pine needle	14,412	124,800
lemon	39,348	109,000
cassia	441	20,000
pine	2,077	1,800
menthol	328	1,600
lime	15	600
others	17,661	114,900
	95,097	774,600

Incongruously, these figures indicate that Canada exports essential oils that it does not produce, such as lemon and cassia oils. This is a result of the structure of the industry. Perfume manufacturers/traders purchase more volume than they require in-house, to benefit from a lower price, and resell the excess. A similar effect explains the large export figures of essential oils in Table 2 for such countries as France, U.K. and Switzerland. These countries have large perfume/flavor industries who buy in quantity and sell the surplus. This is again confirmed in Table 3 which presents the import/export balance for France. This situation helps explain the poor state of the statistics for the industry.

TABLE 3: France Import/Export Balance of Trade in Essential Oils - 1980

(Tonnes)

Oil	Imports	Exports
bergamot	102	82
citronella	298	230
conifer needle	72	34
eucalyptus	653	84
geranium	83	98
lavender	88	1253
lemon	258	326
lemongrass	54	3
mint	674	360
orange	1289	521
petitgrain	116	71
rosewood	24	15
vetiver	78	40
ylang ylang	59	81
other	1498	1940

D. The Existing Cedar Leaf Oil Industry

1. Eastern White Cedar Leaf Oil

Cedar leaf oil, obtained by the steam distillation of leaves and twigs of Thuja occidentalis L. (commonly known as eastern white cedar or arbor vitae), has been an item of commerce since at least the middle of the 19th century. The leaves for distillation were (and still are) obtained from trees growing in the wild state. Generally, the availability of leaves and twigs is directly related either to land clearing or to a small sawmill. Over the years, cedar leaf stills have appeared wherever the trees grow. The tree is native to the Great Lakes - St. Lawrence forest region of Canada where it can be found as far west as Winnipeg, as far east as Nova Scotia, and as far north as James Bay. In the U.S., it can be found in the northern New England states, upper New York state and the upper peninsula of Michigan. The main areas of production of cedar leaf oil traditionally have been in New York, Vermont, the eastern townships and Gaspe peninsula of Quebec and southeastern Ontario. Recently, some oil has been produced in Michigan close to the Canadian border.

Historically, cedar leaf oil production has been a small local industry, a "pocket money" production controlled mainly by farmers who distill the oil in crude equipment during times when they are not occupied with usual farm work. The last 50-odd years have seen a decline in the number of stills as a result of the lack of accessible raw material, economic fluctuations, pest infestations, the cost of fuel and the lack of labor available to collect and trim the leaves and twigs from large branches. The result is that only a few stills are currently operating, with many more intact, but idle.

High quality cedar leaf oil can only be made from needles or twigs. The presence of mature wood in the still results in low quality leaf oil. The wood chemicals that distill over cause a red coloration in the leaf oil. Consequently, "red oil" in the industry has a connotation of poor quality.

2. Cedar Wood Oil

A large volume of cedar wood oil is produced. This material must not be confused with cedar leaf oil. Two types of cedar wood oils are produced in North America. Virginia cedar wood oil is obtained by steam distillation of sawdust, waste wood, old stumps and chipped logs of eastern red cedar, Juniperus virginia L. Texas cedar wood oil is produced by steam distillation of chipped heartwood of Juniperus mexicana Scheide. The two oils are similar in chemical composition and compete in the market place. The production rate of the Virginia oil is about 300,000-400,000 lb. per year; of the Texas oil, about 1-2 million lb. per year. The oils are used in the fragrance industries in products such as soaps, air fresheners, floor polishes and sanitation supplies. The largest use for the oils is as a source of cedrol, their main component. Cedrol is used to make cedryl acetate. The cedar wood oils sell in the U.S. $2-3 per lb. price range.

3. Attempts at Modernization

In the last decade, several attempts have been made by governments and several large private corporations to build and operate modern plants. These generally have failed. The only significant exception is Dominion Essential Oils' operation in Ontario. This plant now dominates production of cedar leaf oil.

Particularly in Quebec, attempts have been made to "industrialize" the cedar leaf oil industry. Five Quebec attempts were learned about in this study. The present status of the five are (8):

a. Huilbec, St. Perpetue (Gaspe near Riviere-du-Loup):

- produced 600 lb. in 1979, nothing in 1980 and 1981.
- under new ownership, has been converted from cedar leaf oil to extracting bark.
- financially in serious difficulty.

b. Jalles Inc., St. Simon d'Auclair (Gaspe near Riviere-du-Loup):

- now only produces fir needle oil.
- most successful of the five, having required only a small infusion of government funds to keep operating.

c. Coop Distillers of Essential Oils, Girardville (Lake St. Jean):

- first year of operation produced about 600 lb. which is still unsold. No production in 1980 and 1981.

d. Marcotte and Sequin, Moffet:

- never produced.
- now closed.

e. Prost Cedar Products:

- closed in 1981.

The Canadian federal government put money (reportedly $1 million) into a plant near Pembroke, Ontario (Quex Oil). The plant never did produce (8, 9). Richardson-Vicks funded a plant in Vermont. One drum of oil was produced before the plant was declared bankrupt (10). Florasynth Inc. and Fritzche, Dodge and Olcott Inc. jointly constructed a plant at Stratford, Quebec. The plant ran for a few years and closed about 3 years ago because it was a money-losing proposition (11).

It was the general consensus of those contacted during this study that any attempt to "industrialize" the cedar leaf oil business would fail. As with much of the essential oil industry, especially the smaller volume oils, cedar leaf oil is a "cottage industry" and an entrant into the field can only survive if his approach is on this basis. The Quebec experience and the scale of operations of Dominion Essential Oils would seem to support this position.

A Quebec civil servant, interviewed on this point, indicated that the needle oil industry is a very marginal one and cannot be recommended to anyone. He added that, currently, the government is not providing aid to the industry because of its small size and because any such assistance is not considered likely to enhance the Province's industrial base (12).

In spite of this dismal record, governments still continue to examine the possibility of fostering essential oil production within Canada. The following active projects were mentioned during this study. The status of each was not pursued (8, 11).

a. Newfoundland:

- production of summer savory (thyme) is under evaluation.

b. Manitoba (near Brandon):

- production of coriander (dropped because of low oil yield), monarda (basil), dill weed and peppermint oils.
- federal government is reportedly involved.
- a company, Valley Essential Oil Co., is involved.

c. Quebec:

- the federal and provincial governments are examining breeding of new species to provide improved yields of needle oils.
- in 1978 and 1980 the Quebec Ministry of Forestry and Rexfor (provincial forestry company) sent commissions to Europe to explore markets for needle oils - to no avail. The impetus in Quebec is a desire to derive income from forestry wastes.

4. Present Production Status

The dominant factor in the production of eastern cedar leaf oil is Dominion Essential Oils Ltd., Bancroft, Ontario. The plant (one module) is the major source of oil with a capacity of 60,000 lb. per year (10).

The two other Canadian sources are both in Quebec: Ardor Ltd. and Botanicus Ltd. Both companies are traders who purchase from small Quebec stills. The larger is Ardor which is reported to handle about 6,000-8,000 lb. per year (13). Botanicus is reported to be dropping out of the business (11). Ardor buys from 5 or 6 different Quebec stills and blends to get a reasonably consistent product.

There are 2 or 3 significant firms in the U.S. After Dominion Essential Oils, the next largest producer is Moore in New York state. Production was about 10,000 lb. in 1980 (10). A Michigan plant (Day) produces some oil as a by-product of a Christmas tree operation.

In total, it is believed that existing production capacity is about twice world demand and, in fact, Dominion Essential Oils alone could likely produce enough oil to meet the current demand (8, 10).

Descriptions of the Dominion Essential Oils Ltd. and the Moore operations follow:

i. Dominion Essential Oils Ltd.

- This is the best and most efficient producer. The facility consists of two modules. Each contains two stills, a boiler and condenser*. The cost of each module is believed to have been about $15,000. Each still is made from one half of a railway tank car. The president of Dominion Essential Oils, Mr. Brown, financed the facility but each module is operator owned. The operator is repaying Brown with oil.
- Cedar brush is packed into a still and steam is passed through the charge. The distillate is condensed by cooling the outlet pipe in a reservoir of cold water (a large bath tub). The condensate is collected and the oil skimmed from the surface of the condensed water, packaged and sold.
- Each still holds about 3 tons of cedar brush and yields 27-30 lb. of oil. The distillation cycle is 3-4 hours.
- In addition to oil from this operation, Brown also buys product from stills in Quebec.

ii. Moore's Plant, New York

- The Moore operation is much smaller and simpler than that of Dominion. The plant has one still. The distillate is condensed by running the distillate pipe along a nearby creek bed. The condensate is collected in an open barrel sitting in the creek and the oil is removed by bailing with a can into the shipping drums.
- Moore obtains oil by three methods:

  a. distillation of brush purchased from local farmers, school children, etc. The current price is about U.S. $90 per ton.
  b. charging a toll of $0.50-$1.00 per lb. of oil for treating other people's brush.
  c. purchase of oil from smaller producers in the region.

- Typically, the yield at Moore's operation is 9-10 lb. from a 1.5 ton batch of brush in a 3-4 hour cycle.

Figure 2 presents some photographs of the Dominion and Moore operations. These provide an indication of the state of the art.

The only production of cedar leaf oil outside Canada and the U.S.A. is reportedly a small amount from North Korea. This is from a different cedar species. A trader in France handles this material. A production estimate of 8,000-12,000 lb. per year was obtained (10).

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* The general technology used in Canada is described by Bender (39).

FIGURE 2. Photographs of the Two Largest Producers of Eastern Cedar Leaf Oil

One of two 2-still distillation modules at Dominion Essential Oils Limited, Ontario.

A local supplier delivering brush for sale to Dominion Essential Oils.

Moore's Operation in New York, the second largest producer.

5. Marketing

i. Distribution

Various forecasts for world demand of eastern cedar leaf oil were obtained during the study. These varied from 40,000 to 120,000 lb. per year. It is believed that the major reason for the wide discrepancy is that the lower estimate reflects what is currently being sold in this very depressed market year, as compared to what is normally sold in an average year. Based on all the evidence supplied by industry contacts, it appears the total world annual demand is about 120,000 lb., of which about 80,000-100,000 lb. are "consumed" in the U.S. The European annual market is about 10,000 lb.; Japan, about 100 lb. (13).

The largest purchaser is Richardson-Vicks Inc., who uses most of its supply in Vicks' Vapo-Rub. Richardson-Vicks estimates its requirement at 35 to 55% of total eastern cedar leaf oil sold (10). Manheimer (2) thought Richardson-Vicks would account for 80-85% of the total; Synfleur (13) estimated Richardson-Vicks at 60% of the total.

Richardson-Vicks purchases directly from 4 producers:

Dominion Essential Oils Ltd., Ontario
Moore in New York state
One other smaller New York distiller
One Michigan distiller.

The North American production not purchased by Richardson-Vicks is bought by dealers.

The significant dealers appear to be:

Polarome Manufacturing Co. Inc., New York
J. Manheimer Inc., New York
The John D. Walsh Co., New Jersey
Ardor Limited, Montreal.

These dealers, in turn, sell directly to end-users or to smaller dealers. The latter are usually manufacturers who buy more than they require, in order to get the benefit of buying in volume, and then resell the extra amount. It was not learned if Ardor sells primarily to end-users or primarily to the large U.S. traders.

Richardson-Vicks, reportedly, buys some oil from Manheimer (13) and/or Polarome (8). Two large customers of the John D. Walsh Co. Inc., are Haarmann and Reimer Corp. and V. Mane et Fils. The former is a fragrance manufacturer and broker; the latter, a French dealer.

Based on an assessment of information obtained, it is estimated the normal annual purchase of oil directly from the producers and Ardor Ltd. is approximately as follows:

	lb. per year
Richardson-Vicks	45,000 - 65,000
Polarome	20,000 - 30,000
John D. Walsh	10,000 - 15,000
Manheimer*	significant quantity
TOTAL	120,000

Richardson-Vicks' purchase of 45,000-65,000 lb. per year includes both its U.S.A. and offshore requirements. The latter represents well over half its total purchases and is obtained principally from Dominion Essential Oils.

ii. End Use Pattern

The largest use of cedar leaf oil is in patent medicines. Richardson-Vicks' Vapo-Rub** represents about half the total market. Richardson-Vicks' specifications for cedar leaf oil are presented in Appendix F. A product similar to Vapo-Rub is manufactured by Mentholatum Corp., New York. It was not learned if this company used cedar leaf oil***. The next largest use is believed to be for a horse linament. This employs low quality oil cut with glycerine. This application might take 2,000 lb. per year (10).

Some oil is used in the manufacture of fine fragrances, room deodorants and car fresheners where a herbal scent is wanted. A recent use is the re-odorizing of sawdust used in fuel logs. Because cedar does not have an odor attractive for fine fragrances, its application is limited primarily to industrial uses. A small quantity is used in men's fragrances. The industrial fragrance market is one with a low but steady growth rate, but one requiring low cost perfumes.

A very small quantity is sold in some drug stores at high unit prices for limited applications, e.g. to a hunter who wishes to mask his scent. The total Canadian sales in this category are probably less than 50 lb. per year. A Montreal company, Atlas Laboratories Ltd., a drug wholesaler and repacker, supplies part of this market and buys about 25 lb. of oil per year (11). Sales in drugstores in Quebec stopped 10-15 years ago.

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* Manheimer's volume was not established. However, to reach a total of 120,000 lb. per year, Manheimer's volume could be the difference of 10,000 to 45,000 lb. per year.

** 0.4% cedar leaf oil, 2.6% menthol, 0.076% thymol, 4.73% camphor, 4.5% turpentine, 1.2% eucalyptus oil, 0.5% myristica oil.

*** The company did not respond to the questionnaire.

The cedar leaf oil consumption values reported by companies during the survey are given in Table 4.

TABLE 4: Reported Consumption Rates of Cedar Leaf Oil

Company	Stated Amount Being Purchased lb. per year	Stated Use
Richardson-Vicks Inc.	approx. 50,000	Vicks Vapo-Rub
Haarmann and Reimer Corp.	6,000	Fragrance in dry bleaches, underarm deodorants, tampons
PFW Div. Hercules Inc.	1,025	Fragrances
Fritzshe, Dodge & Olcott Inc.	800	Fragrances
Givaudan Corp.	400	Fragrances
Naarden International USA Inc.	200(U.S.)	Fragrances
Proctor and Gamble Co.	33	Fragrances
Elias Fragrances Ltd.	20	Air freshener (?)
International Flavor and Fragrances Ltd.	Nil	
Medallion International Ltd.	2,200	Air freshener
Ungerer	4,000	Fragrances
Total	approx. 65,000	

The total is some 65,000 lb. per year. Since the companies listed include the largest consumer of fragrances (Proctor and Gamble) and the five largest fragrance manufacturers, the reported normal annual market (page D-7) of 120,000 lbs. may be too high.

iii. Price

Table 5 presents the price history of eastern cedar leaf oil since 1960, as derived from U.S. import statistics. Also presented is a breakdown of U.S. imports by country. The price has climbed steadily from 1973 to 1980, but dropped dramatically in 1981. The volume of U.S. imports has fluctuated widely over the period, from a low of 3,600 lb. in 1975 to a maximum of 74,800 lb. in 1973.

Currently, the requirement for Richardson-Vicks' offshore plants is shipped directly from Canada and would therefore not show up in U.S. imports. It is not known if this was the case in previous years. Assuming Richardson-Vicks purchased 30,000 lb. for its offshore operation, and all this came from Dominion Essential Oils Ltd., the maximum Canadian production in 1980 would, therefore, have been about 50,000 lb.

TABLE 5: Price History of Eastern Cedar Leaf Oil

	Year	U.S. Imports (1,000 lbs.)				Average Value FOB Country of Origin U.S. $ per lb.
		Canada	W. Germany	Other	Total	
avg.	1960-64	6.2		0.2(1)	6.4	2.75
	1965	6.8		0.7	7.5	2.72
	1966	16.5		0.9	17.4	4.20
	1967	24.9		0.4	25.3	4.91
	1968	23.7			23.7	4.27
	1969	11.1		11.9(2)	23.0	3.29
	1970	17.7			17.7	6.49
	1971	10.8			10.8	5.03
	1972	50.8	1.9		52.7	3.12
	1973	74.3	0.1	0.4(3)	74.8	3.30
	1974	32.0	0.3	7.8(4)	40.1	7.50
	1975	2.9	0.4	0.3(1)	3.6	9.69
	1976	21.1	0.1	1.1(5)	22.3	11.23
	1977	12.3	0.3		12.6	13.19
	1978	13.5	0.2		13.7	14.26
	1979	16.8	0.2		17.0	16.24
	1980	20.9	0.2		21.1	17.93
	1981					10 - 13 (6)

1) France; 2) Brazil; 3) Morocco; 4) 6.5 Italy, 1.3 other; 5) Holland; 6) non-Richardson-Vicks' purchases in September - October.

In 1979-80, there was an apparent shortage and reportedly Ardor Ltd., Montreal, attempted to raise the price. Richardson-Vicks allowed its suppliers to follow this price lead. The price eventually reached the U.S. $22 per lb. range. This brought on all kinds of product which glutted the market. This glut still exists and has resulted in a dramatic fall in prices. In August, the price, delivered in New York, was in the U.S. $15-16 per lb. range. By October, it had fallen to $10-12 per lb.

It is rumoured that Richardson-Vicks still has all its 1980 purchases in inventory and is attempting to dispose of half of it. Richardson-Vicks admits to a large inventory surplus and estimates the industry has 9 to 18 months consumption in warehouses, "much of it in Richardson-Vicks' warehouses" (10). Ardor Ltd. considers the current oversupply amounts to 12,000 lb. and is sufficient to depress the market for 2-3 years (8). At the end of October 1981, John D. Walsh Co., stated it had 5,200 lb. in stock (1,200 lb. in New Jersey and 4,000 lb. in Canada) and sales were very depressed. Walsh also said one of its large customers, who usually takes 4,000 lb. per year, might purchase 800 lb. this year. As an example of the seriousness of the situation, Ardor Ltd. said it had recently bid U.S. $14 per lb. for a 100 lb. order, a very small order, and was

undercut by another supplier. Botanicus, the other Quebec broker, is reportedly getting out of the business because of the depressed situation.

Richardson-Vicks' practice was to negotiate annual contracts with its suppliers. The contracts specified quantities but left price open. This worked well until the recent price war/glut situation developed. The company concluded that if an acceptable price is paid, the periods of shortage experienced in the past will not occur. As a result, the company has changed its purchasing policy. A fair price has been calculated for each of its four suppliers based on that supplier's cost. Richardson-Vicks now pro-rates its requirements to the four suppliers at this calculated price. While this has resulted in an overall higher cost to Richardson-Vicks, the company is keeping its suppliers happy and healthy and believes it can now be assured of adequate supplies in the future.

The following calculations were provided by Richardson-Vicks (10). These form the basis for determining the price it pays its suppliers:

Cost item	Cost of cedar leaf oil U.S. $ per lb.
Brush (at $90 per ton)	11.25
Fuel (oil or gas) (at $40 per batch and 6 tons of brush per batch)	0.83
Labor and waste disposal (at $30 per batch and 6 tons brush per batch)	0.63
Cost before depreciation and profit	12.71

This calculation assumes a yield of 8 lb. of oil per ton of brush. Different yields change the numbers accordingly. For example, at 10 lb. of oil per ton, the cost is $10.17 per lb.

Based on this calculation Richardson-Vicks would pay a supplier about U.S. $17 per lb. assuming a $4 per lb. profit after allowing for depreciation. Using a cost of $15,000 for the Dominion Essential Oil plant, depreciation approximates 30 ¢ per lb.

The oversupply situation is so severe that the allocated sales to Richardson-Vicks from its four suppliers are not sufficient to keep the four operating at anywhere near capacity. The result is that material in excess to that contracted by Richardson-Vicks is sold at much lower prices. Probably 60% of current production of these suppliers is sold under the Richardson-Vicks' contract price and 40% is sold in the $10-13 per lb. price range. Producers outside the Richardson-Vicks' agreement probably sell all their output at this low price.

Richardson-Vicks said the actual demand is not sufficient to support the Richardson-Vicks' price of U.S. $16.75 per lb. and it can see no market development that will increase demand (10). This was the general consensus of other companies interviewed. Richardson-Vicks estimates the "free" price will remain in the $10-13 per lb. price range for at least 2-3 years. Ardor Ltd. said that with the current oversupply problem, it calculates a new plant bringing 4,000 lb. per year of oil onto the market would depress the price another $1 per lb.

iv. Capital Costs of Production Facilities

A spokesman for the Quebec government said that the 4-5 significant needle oil plants in eastern Canada cost $50,000-$100,000 each to build (12). The plant built jointly by Florasynth Inc. and Fritzsche, Dodge and Olcott Inc. cost $35,000 (7-8 years ago) and had a capacity of 25,000 lb. per year (1 shift basis for 100 days per year; 4 stills; 16 tons brush per 4 stills per 6 hours). Ardor Ltd., stated a less sophisticated but adequate plant of this capacity could be built for even less today (11). Ardor also estimates that a small 5,000 lb. per year plant can be built for $10,000 (11).

The Dominion Essential Oils plant is reported to have cost approximately $15,000. It can produce 60,000 lb. per year (10).

E. Market Survey Results

1. Questionnaire

A total of 304 companies were sent questionnaires, 68% in the U.S., 24% in Europe and 8% in Canada. The companies are listed in Appendix D.

Of the total 304 sent, 63 questionnaires or 21% were returned. Of these, 41 expressed no interest; 22 some interest. The geographical distribution of the replies was 71% U.S., 21% Europe and 8% Canada - a good correlation with the geographic distribution of questionnaires sent out.

Based on later follow-up discussions with industry representatives, it was concluded no companies important to the study had been omitted.

All the returned questionnaires are on file at the Science Council of B.C.

i) Negative Responses

Of the 41 companies who expressed no interest in cedar leaf oil, either as an oil or as a source of thujone, 78% were users of essential oils while only 12% were brokers or traders.

Some 68% said they had no application for the oil and 33% said it was too expensive. Seven respondants gave a price range at which they would be interested. These ranges, plus, when stated, the quantity they might purchase, were:

Required Price Range U.S. $ per lb.	Quantity lb. per year
14	
11 - 12	
10 - 12	4,400
9 - 12	
1 - 2	
0.25 - 0.50	22,000,000
0.30	

Even the top prices quoted are about half the estimated selling price of B.C. produced oil (3).

ii) Positive Responses

Twenty-two respondants expressed interest in cedar leaf oil. Among them, they indicated a total annual requirement of 60,000-95,000 lb. per year.

Of the 22 interested companies, the predominant number, 68%, were brokers/traders and many qualified their interest as being contingent on a market survey of their clientele. Four of the 5 European, 10 of the 15 U.S. and 1 of the 2 Canadian respondants were traders/brokers.

Seven users said they were interested. These were:

Bush Boake Allen Inc., (U.S.)	- perfumer; no quantity provided.
Perry Bros. (Mallinckrodt) (U.S.)	- manufacturer of aromas; required price $8-10.00 per lb.
Amway Corp. (U.S.)	- perfume user; if price were U.S. $3-3.50 per lb., a research program might be initiated that, if successful, might result in a 35,000-45,000 lb. per year market.
Elias Fragrances Inc. (U.S.)	- perfumer; curious; might use 100 lbs. per year.
Medallion International Inc. (U.S.)	- perfumer; might use 2000-6,000 lb per year if price advantage over eastern oil.
Parento Ltd. (Canadian)	- looking for substitute for eastern oil.
Naarden International Holland BV	- 2000 lb. per year possible in 3-5 years.

2. Field Trip

Those companies that responded positively to the questionnaire plus companies, such as Ciba-Geigy, Givaudan and Firmenich, known to have expressed interest directly to Dr. Kutney in the past, plus some other likely companies that came to our attention subsequent to mailing the questionnaire e.g., SCM and Biddle Sawyer, were contacted in a follow-up program. This involved telephone and telex (Europe) contacts, followed by direct visits to certain North American locations.

In total, 31 organizations were contacted. Their names and addresses are presented in Appendix G. File notes were written summarizing all significant discussions. These are on file at the Science Council office.

The follow-up is believed to have covered a good sampling of companies that would be interested in cedar leaf oil and/or thujone. Companies contacted included:

a) the six largest manufacturers of perfumes and flavors in the world:

International Flavors and Fragrances Inc.
Naarden International USA Inc.
Givaudan Corp.
Fritzche, Dodge and Olcott Inc.
Firmenich (U.S.) Inc.
Haarmann and Reimer Corp.

b) four of the largest chemical companies in the world:

BASF
Bayer
Mitsui
Nestle

c) the largest user of fragrances in the world:

Proctor and Gamble Co.

d) the largest user of cedar leaf oil:

Richardson-Vicks

e) the largest traders of cedar leaf oil:

Polarome Manufacturing Co. Inc.
J. Manheimer Inc.
Synfluer, Division of Nestle Co.
Centflor Manufacturing Co. Ltd.
Ardor Limited

f) large European traders of essential oils:

Paul Kaders, GmBH
Siber Hegner Raw Materials Ltd.
Vioryl SA

g) a recognized authority on cultivation of essential oil plant species:

Dr. B.M. Lawrence

h) the largest processor of wood terpenes:

SCM Corp.

i) Sale of B.C. Cedar Leaf Oil for Use as an Oil

a) Discussions

Little interest was evident in the possible purchase of B.C. western cedar leaf oil for use as an oil. Any interest expressed in the questionnaire generally evaporated in the follow-up discussion when a price in the $15 per lb. range was discussed.

No market growth in the demand for cedar leaf oil was evident. The cedar leaf oil market is very inelastic. More production will not create new demand, even if the new production was lower priced. Consequently, any market B.C. could capture would likely be at the expense of Ontario and

Quebec producers - scarcely of overall benefit to Canada. To capture a market, B.C. oil would have to be priced 10-15% below the price of eastern white cedar oil - currently about U.S. $10-13 per lb. delivered in New York. Even then, firm business would only be obtained if B.C. could demonstrate long-term reliability of supply. Subject to these major, critical conditions of low price and firm source, B.C. would have no difficulty establishing a good marketing network. Any of the major traders would be willing to warehouse the oil and sell it on a commission basis.

Western red cedar leaf oil was generally judged to have slightly different odor characteristics than eastern cedar leaf oil. Several companies were interested in the oil for that reason. These were:

	Stated Approximate Requirement (lb. per year)
Medallion Internationl Inc., U.S.A.	2,000 - 10,000
Langley-Smith and Co. Ltd., U.K.	several tonnes
Soda Aromatics, Japan	200 - 1,000
Firmenich Inc., U.S.A.	1,000 - 20,000

These companies were the only ones expressing interest in western red cedar leaf oil because of its uniqueness. Any other interest was as a replacement for eastern leaf oil and interest was contingent on a lower price than that of the eastern material. These four companies could constitute a market varying from 5,000-40,000 lb. per year, based on their own estimates. Using these figures, however, would likely be dangerous. Medallion said the oil would have to offer a price advantage over eastern oil to be acceptable. Soda Aromatics thought a price of $20 per lb. to be too high. A price in the $20 per lb. range might be acceptable, in the opinions of Firmenich and Langley-Smith. However, Firmenich said successful commercialization of their concept could be 5-10 years off and price reduction would be expected when the production rate of the oil increased. Langley-Smith's enquiry may duplicate an interest by PFW, Division of Hercules Inc. in the U.S., and further investigation might see this interest evaporate. The true requirements of these four companies obviously calls for more detailed evaluation.

b) Comments of Companies Interviewed

(a) Amway Inc. (15)

- interest in the B.C. project was sparked by research speculation that cedar leaf oil might replace lemon oil in Amway's furniture polish.

- if this were possible, 35,000-45,000 lb. per year of cedar leaf oil would be used.

- only feasible if price were U.S. $3-3.50 per lb. delivered, Michigan.

- major market research study would be required to evaluate acceptance of cedar versus lemon oil.

(b) Ardor Ltd./Florasynth (8, 11)

- Florasynth has a $125 million per year fragrance business, but consumes less than $1000 worth of cedar oil.

- Ardor is the major trader for Quebec cedar leaf oil.

- recommended that B.C. discontinue the project.

- the only route to capture market would be to displace eastern oil by undercutting price.

- the market is stagnant with a large amount of idle production capacity.

- Ardor would be reluctant to take on selling B.C. oil even at a much higher commission than normal, because there is so little potential.

- the president of Ardor volunteered to address the Science Council to discuss frankly the present and foreseeable situations. His presentation would attempt to dissuade the Science Council from further research expenditures on this area. He is a member of a government committee set up to assess the essential oil industry in Canada.

(c) Centflor Manufacturing Co. Inc. (16)

- claims to be significant broker of cedar leaf oils.

- only possiblity for B.C. oil would be to replace eastern oil.

- no future in such an approach.

(d) Elias Fragrances Inc. (17)

- interest in questionnaire was motivated by curiosity.

- at most, might use 100 lb. of cedar leaf oil, if a new product application developed successfully.

(e) Firmenich Inc. (18, 19, 20)

- a large fragrance manufacturer.

- company is very interested in B.C. oil as a new fragrance, not as a replacement for eastern oil.

- the interest is because of its high thujone content and, hence, its unique fragrance.

- attempting to develop a new fragrance for household products, air fresheners and men's cologne, might take 5-10 years to commercialization.

- if successful, Firmenich could require from 1000 to 20,000 lb. depending on the degree of success.

- while a price in the $20 per lb. range might be initially feasible, especially if there was an indication that price might come down as the production rate grew, a price this high does take the edge off Firmenich's interest.

- Firmenich would expect that B.C. could never start with anything but a "cottage industry type" facility which would be lucky to sell 2000 lb. in the first year.

(f) Fritzsche, Dodge and Olcott Inc. (21)

- in top five or six perfume/flavor manufacturers.

- already has several good "cedar fragrances" in inventory and doesn't need another.

- if price were in the $2 per lb. range, definite interest; if $5 per lb. range, interest would be less; and $15-$20, no interest at all.

- could see no hope for B.C. produced oil.

(g) Givaudan Corp. (22)

- large perfume manufacturer.

- worldwide, company purchases $30-40 million worth of essential oils.

- cedar oil is a tiny part of the total essential oil industry and getting smaller.

- replacement materials exist for cedar leaf oils.

- saw no hope for use of B.C. oil by the fragrance industry in any significant way.

(h) Haarmann and Reimer Corp. (14)

- sales of $130 million of fragrances, flavors, essential oils and related materials.

- B.C. oil has fragrance distinct from that of eastern oil and could not simply replace eastern oil in perfume formulations.

- H & R has a list of fragrances acceptable for use in its fomulations.

- a sample will be sent to Germany to assess the chances of getting B.C. oil on the accepted list - unlikely.

- difficult to see any potential for B.C. oil at a price of $15-20 per lb.

- at this price, the oil would only sell as specialty fragrance and, as such, would likely only reach an eventual sales level of 10,000 lb. per year ± 30%.

- the cedar fragrance can only expect to capture a reasonable volume market in commercial cleaners. This market demands low cost fragrances.

(i) International Flavors and Fragrances Inc. (41)

- the world's largest fragrance and flavor company.

- B.C. oil has a pleasant odor but one that limits its use to household cleaners - an application that demands a blend of fragrances in the U.S. $3-5 per lb. range. Terpineol selling in the $1 per lb. range has 90% of this market.

- there are many low cost items with pleasant odors available to formulators of household products. Consequently, the chances of them using B.C. oil, even if priced correctly, are small.

- B.C. oil would have to sell in the $2-4 per lb. range to expect any significant market.

- at $2-4 per lb. IFF's interest would still be minimal.

(j) J. Manheimer Inc. (2)

- second largest essential oil dealer in the U.S.

- picked by MacMillan Bloedel in late 1960's to market its cedar leaf oil production.

- cedar leaf oil is a very desirable essence as it has a real impact in places where it can be used.

- market is stagnant. Richardson-Vicks is continually attempting to phase thujone out of Vapo-Rub.

(k) Medallion International Inc. (23)

- small fragrance manufacturer for industrial cleaners and air freshener industry.
- most interested in trying a new scent and intrigued with B.C. cedar oil.
- if application successful, could use 2,000 to 10,000 lb. per year.
- B.C. oil would only be acceptable if it could offer some price advantage over eastern cedar leaf oil.
- wanted a sample to test market.

(l) Mitsui & Co. (Canada) Ltd. (24)

- using its trading offices throughout the Far East and its operation in Japan, Mitsui surveyed the market for cedar leaf oil in the Far East.
- one firm enquiry for a quote resulted.
- Soda Aromatics, second or third largest perfumery company in Japan, wished a quote on 200-1,000 lb.
- a follow-up telex, stating a possible price in the $20 per lb. range, elicited a statement that this seemed out of line.

(m) Naarden International USA Inc. (25)

- second largest perfume/flavor manufacturer in the world.
- the U.S. company uses only 200 lb. per year of eastern cedar leaf oil.
- interest in B.C. oil for new formulation: perhaps 1000 lb./year in 3-4 years but only at low price.

(n) PFW Division of Hercules Inc. (26)

- consumes 1025 lb. per year of eastern cedar leaf oil in two perfume fragrances.
- the oil is French oil and costs U.S. $32 per lb.
- B.C. oil could only find a market by displacing eastern oil - a long and tortuous road. A minimum of 3-4 years would be required to convince the industry that B.C. was going to be a serious, long-term factor.

(o) Polarome Manufacturing Co. Inc. (27)

- largest essential oil dealer in U.S. and largest dealer in eastern cedar leaf oil.
- B.C. oil would have to sell for a 10-15% discount, delivered New York, compared to eastern oil.
- use of cedar leaf oil is declining.
- present sources of supply are more than adequate.
- any B.C. production will depress further an already depressed market.
- B.C. would be wise to abandon the project.

(p) Proctor and Gamble Co. (28)

- PG is the world's largest user of perfumes.
- in 1980, it used 33 lb. of eastern cedar leaf oil but 300,000-400,000 lb. of the much cheaper cedar wood oil.
- absolutely no interest in purchasing B.C. oil.
- even if there was an application, the price of $15 to 20 per lb. is much too high.
- 3-5 years is typical to introduce a new perfume to the soap industry.
- other soap manufacturers would likely be equally as discouraging.
- Tide, PG's most successful soap, might consume 25,000-50,000 lb. of essential oil in its fragrance formulation.

(q) Quebec Government (12)

- the coniferous needle industry is a very marginal business that cannot be recommended.
- the constraint to both healthier volumes and prices is the market, not the production capacity.
- 60-70% of this year's Quebec production is unsold.
- the Quebec industry is so minor that any government support efforts are not merited - even the collection of statistics.

(r) Richardson-Vicks Inc. (10)

- Vapo-Rub is the flagship of the company and cedar leaf oil is a vital ingredient of the product. Consequently, management are most reluctant to change any component.

- significant cost advantages of B.C. over eastern oil would have to be demonstrated, e.g.,

    a) appreciable cost saving (i.e. U.S. $11-12 versus present U.S. $19.50 per lb.) or

    b) demonstration that the B.C. oil is so potent that the Richardson-Vicks' consumption could be cut in half.

- no more R & D should be spent in B.C. on this project. The business is so simple no R & D is required.

- rather, in 3-4 years time, if the current glut of oil is worked off, a quick market survey should be done. If the situation looks good, simply build a $15,000 plant like Dominion Essential Oil has in Ontario.

(s) Synfleur (13)

- fourth or fifth largest dealer of essential oils in the U.S.

- number of consumers of cedar leaf oil is limited and no growth potential is evident.

- any market B.C. could capture would be at the expense of Ontario and Quebec producers.

- the market is depressed. Richardson-Vicks is attempting to reduce its inventory by 50%.

- the essential oil industry is largely a "cottage type" industry dominated by third world countries desperate for hard currency. Essential oils are in danger of substitution by synthetics.

- B.C. production has "absolutely no future" and B.C. should drop this type of project.

(t) Synfuel Conversion (29)

- promoting a process to use wood wastes to make power, charcoal and/or gaseous fuels.

- only interested in a B.C. cedar leaf plant if the amount of waste was large and bore zero costs to the Synfuel plant.

(u) The John D. Walsh Co. Inc. (30)

- a large broker of essential oils and important in eastern cedar leaf oil marketing.
- provided samples of B.C. oil to a selection of its clients.
- no interest shown.
- no hope for a viable operation in B.C.
- an industrialized producer could never survive in this business. With some exceptions, the essential oil business exists because it is a "cottage-type" industry.

In addition to the above organizations, contact, via telex, was made with three dealers in Europe: Fuerst Day Lawson Ltd., U.K. (Oct. 19, 1981); Paul Kaders GmBH, West Germany (Oct. 18, 1981) and Vioryl S.A., Greece (Oct. 19, 1981), requesting details on their indicated interest. At the time of writing this report, no replies had been received.

Too late for follow-up, a letter was received from Langley-Smith and Co. Ltd. (31) expressing interest in examining two samples of oil for possible direct incorporation in toiletries and perfumes and as a source of thujone. If successful, a consumption of several tonnes per year could be foreseen. The letter refers to receipt by Langley-Smith of the questionnaire from Hercules Ltd., London. PFW Division of Hercules Inc., in the U.S., mentioned it purchases 1025 lb. of high priced cedar leaf oil annually from France. Perhaps this Langley-Smith enquiry is connected with the PFW requirement.

ii) Sale of B.C. Cedar Leaf Oil as a Source of Thujone

a) Discussion

In addition to markets for B.C. cedar leaf oil for direct use, the possibility of selling the oil as a source of thujone, in particular α - thujone, was pursued in the interviews.

To aid in discussion, a "handout" summarizing the work on the chemistry of thujone and its derivatives, including the work by Dr. Kutney, was provided to all contacts. A copy of this "handout" is presented in Appendix A.

With one exception, no contact was aware of any existing use of thujone or of any research work based on the use of thujone as a chemical feedstock.

One company interviewed* stated it sells thujone and two derivatives. The market was stated to be small and specialized.

Should a market for thujone exist, there are several other sources besides western red cedar leaf oil. Examples given were Dalmatian sage, wormwood, dill seed, tansy, artemisia, African wormwood, armoise and shiu oils.

Dr. Lawrence, R.J.R. Technical Co., is a recognized authority on the growing of plants for essential oil production and on the recovery of the oils and their chemical properties. He was visited specifically to explore this question of alternative sources of thujone. There are many plant species that produce high thujone content oils, but fewer produce oils rich in a α-thujone. Assuming the desire is to produce a α-thujone, Dr. Lawrence developed the following costs for preparing α-thujone from suitable oils - oils his experience judges would be competitive with western red cedar leaf oil (9):

	Oil			
	Armoise	Dalmatian Sage	Eastern White Cedar Leaf	Western Red Cedar Leaf
Published price of oil - U.S. $ per lb.	18	30	12	20
α-thujone content %	80	60	50	70
Price of oil after distillation to produce 80% α-thujone - U.S. $ per lb.	18	47	38	29

These calculations indicate that armoise would be a significantly cheaper source of α-thujone than western red cedar leaf oil. Lawrence, however, would actually recommend Dalmatian sage if a real market for α-thujone existed. Based on actual growing tests at the RJR Technical Co., Avoca experimental farm in North Carolina, Lawrence believes a Dalmatian sage variety could be selected that would give an oil with a higher α-thujone content than the sample used. The ease of growing and harvesting sage on a mechanized farm favors its utilization and would likely result in a lower cost source of α-thujone than

* Confidentiality requested.

either armoise or western red cedar leaf oils. He estimates that to select and put into production the most desirable species would take 3-4 years.

Presently, armoise oil is a commercial product. However, it is produced from wild plants in Morocco and has a limited availablity. Two types of oils are produced. One has 30% α-thujone; the other 60%. The high thujone material can only be sold if diluted with the 30% material. Armoise oil could be produced from plants grown commercially, say, in Spain or South Africa, for a price probably in the $12 per lb. price range (9).

Several contacts expressed interest in the chemistry of thujone derivatives. The molecule is a most interesting one. However, to have any application to the perfumery, agricultural or pharmaceutical industries, it appears a cost below $5 per lb. is mandatory. Exceptions would be for very low volume, high priced commodities.

As discussed below, the only companies that expressed concrete interest in western red cedar as a source of thujone were:

Ciba-Geigy
SCM Corp.

Ciba-Geigy has an interest in thujone for both agricultural chemicals and pharmaceuticals manufacture. In the Ciba-Geigy screening of Dr. Kutney's derivatives, apparently none as yet has shown promise for agricultural chemicals. Even if one did, the cost of thujone would likely have to be below $5 per lb. (33). Ciba-Geigy's pharmaceutical people are reportedly quite interested in one of Dr. Kutney's derivatives. However, it is likely that thujone at a price in the $20 per lb. range would be of little interest (33). SCM has requested a sample of western red cedar leaf oil to follow up a research idea concerning thujone, although SCM admits the prospects of success are not great.

b) Comments of Companies Interviewed

Below are comments made on thujone by the various contacts:

(a) Ardor Ltd. (8)

- the University of Chicoutimi in Quebec has a program on thujone derivatives thought to be somewhat similar to that at U.B.C.

(b) Biddle Sawyer Inc. (32)

- trader handling a lot of armoise from Morocco.

- knew of no existing or potential market for thujone.

- even if a use existed, the company knew of no chemical synthesis relative to the perfume/aroma industry that could support a feedstock price in the $15-20 per lb. range.

- knew of no customer interested in the type of armoise oil high in thujone content.

(c) Ciba-Geigy Corp. (33)

- Ciba-Geigy screens the chemical derivatives of thujone generated by Dr. Kutney.

- company has a very high regard for Dr. Kutney and U.B.C. and values the relationship and wishes it to continue.

- thujone is a most interesting molecule, particularly its stereochemistry. C-G has identified 6-7 directions in Kutney's work that are interesting, however, to date no success has been realized for agricultural applications. One development seems to have interest to C-G's pharmaceutical people.

- for economic viability, a thujone derived agricultural chemical could likely not cost C-G more than U.S. $2.50-$3.00 per lb. Some 600,000 lb. of thujone would be consumed. Thujone at $15-20 per lb. would likely never be of interest. The most expensive chemical feedstock C-G uses costs $12 per lb. While the product works well, it has had a difficult marketing history because of high cost.

- while pharmaceuticals can afford somewhat higher feedstock prices, it is unlikely a price of thujone in the $15-20 range could be viable. This is because other costs (e.g., labor, product testing and quality control) are much higher than in the case of agricultural chemicals because the volumes are much lower.

(d) Fritzsche, Dodge and Olcott Inc. (21)

- because thujone is an interesting molecule, a cheap source would be of great interest for R & D purposes.

- price would have to be in the $2-3 per lb. range.

- large volume fragrance formulations, such as would be sold to a soap manufacturer, must sell under $6-8 per lb. Consequently, thujone as a feedstock for manufacture of a material for use in such a formulation would have to sell for $ 2-2.50 per lb.

- about 8 years ago, the company looked at recovering thujone from Dalmatian sage oil. The main objective was to render the sage oil saleable; i.e., the removed thujone was to be essentially a zero-cost by-product. The project was dropped because of the toxic nature of thujone and the cost of proceeding to synthesized products from thujone.

- knew of no existing or potential uses for thujone.

(e) Givaudan Corp. (22)

- knew of no potential use of thujone as a feedstock in perfumery, but guessed, if one existed, thujone would have to be about $1 per lb. to be of interest.

(f) Haarmann and Reimer Corp. (14)

- unaware of any use for thujone.

- a few years ago, a company approached H & R for 500 lb. per year of thujone. H & R decided it could not afford to make thujone at this low rate.

- the handout on thujone chemistry was sent to Germany for comment.

- in March 1979, H & R opened its second synthetic menthol plant in the U.S. This plant is still operating at less than capacity because of importation of low cost Chinese material - a constant danger in the essential oil industry.

(g) International Flavors and Fragrances Inc. (41)

- while thujone is an interesting molecule, IFF is not aware of any existing or potential use in perfumery.

- chances of interesting a fragrance manufacturer to embark on a long program to explore the potential of thujone is slight.

- in 1980, IFF used 20 and 10 lb., respectively, of thujanol and thujone.

- thujone as a chemical feedstock would have to cost in $3-6 per lb. range.

- if a very special fragrance could be made from thujone, a price up to $10 per lb. might be feasible but the volume would be small.

- 10% of IFF's fragrance output is classified as high priced; no one could afford to make a chemical feedstock specifically for this part of IFF's account.

- it could take 5 years to bring a fragrance to commercialization.

- a typical successful application for thujone in perfumery, assuming a price in the $5 per lb. range, could consume about 10,000 lb. of thujone per year.

(h) J. Manheimer Inc. (2)

- not aware of any use for thujone.

(i) Naarden International U.S.A. Inc. (25)

- to be of interest as a feedstock for perfumery, thujone would likely have to sell for less than $5 per lb.

(j) Pacific Forest Research Lab. - Dr. E. von Rudloff (34)

- a leading world expert on conifer needle oils.

- not aware of a present use or market for thujone.

- about 7 years ago, studied needle oil production for Alberta Research Council. The project proved uneconomical because of high leaf collection costs.

(k) Polarome Manufacturing Co. Inc. (27)

- knew of no market for thujone.

(l) Proctor and Gamble Co. (28)

- if thujone could be used to make a successful soap fragrance, it might have a volume of 100,000 plus lb. per year, worldwide.

- but to be successful thujone would have to sell in the $1-2 per lb. range.

(m) Richardson-Vicks Inc. (10)

- aware of no markets, existing or potential, for thujone.

- a few years ago, the company examined the use of thujone to formulate a synthetic oil to free itself from the problems associated with securing natural oil. Nothing came of it.

(n) R.J.R. Technical Co. (9)

- if a market existed, thujone could be made in large quantity from thujene, a waste product of pine oil production in Europe.

- considerable interest was shown in a synthesis suggested by Dr. Kutney whereby a thujone derivative (which must be stable) might be utilized to make germacrene D. Dr. Lawrence requested that Dr. Kutney contact him.

(o) SCM Corp. (42, 43)

- not aware of any markets or R & D work on developing uses for thujone.

- confirmed by a library search.

- asked for a sample for a SCM researcher who has an idea for using thujone that might consume 5000 lb. per year maximum.

- rated the idea as unpromising.

(p) Shell Chemical Co.*

- could use 22,000,000 lb. per year thujone as a chemical feedstock if price $0.25-0.50 per lb.

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*see response to mail questionnaire.

F. Health Issue

The handbook "Perfume and Flavor Chemistry" provides the following comments on thujone (35):

> "Thujone has been in the limelight for its physiological effects, not fully elucidated and poorly included in perfumery literature, for many decades. Herbs, containing essential oils in which thujone forms a major component, have been under suspicion by the food authorities, and many products containing thujone-bearing oils or extracts have been banned from food, beverages, etc.
>
> "The toxicity of thujone is roughly estimated at three times that of nitrobenzene, but it is not possible to compare the two, since the effect of thujone is entirely different, sometimes classified as "Curare-like" or paralyzing on the human CNS or heart system. The thujone content of certain Artemisia species, used in "Absinthe" alcoholic beverage, was responsible for the ban of certain brands of alcoholic beverage in the 1930's in France.
>
> "Thujone is by some authorities considered the most toxic of all commonly occurring components of essential oils".

The Food and Cosmetics Toxicology reports the following biological data on cedar leaf oil (36):

> "Acute toxicity. The acute oral LD_{50} value in rats was reported at 0.83 g/kg (0.69-0.97 g/kg) (Moreno, 1973). The acute dermal LD_{50} in rabbits was reported as 4.1 g/kg (2.8-6.8 g/kg) (Moreno, 1973).
>
> "Irritation. Undiluted cedar leaf oil applied to the backs of hairless mice produced no irritating effects (Urbach & Forbes, 1973). Applied full strength to intact or abraded rabbit skin for 24 hours under occlusion, it was moderately irritating (Moreno, 1973). Tested at 4% in petrolatum, it produced no irritation after a 48-hr. closed patch test on human subjects (Kligman, 1973).
>
> "Sensitization. A maximization test (Kligman, 1966) was carried out on 25 volunteers. The material was tested at a concentration of 4% in petrolatum and produced no sensitization reactions (Kligman, 1973).
>
> "Phototoxicity. No phototoxic effects were reported for cedar leaf oil (Urbach & Forbes, 1973).
>
> "Cedar leaf oil was granted GRAS status by FEMA (1965) and is approved by the FDA for food use (21 CFR 121.1163). The Council of Europe (1970) included cedar leaf oil (Thuja occidentalis L.) in the list of flavoring substances

temporarily admitted for use, possibly with a limitation on the active principle in the final product. The Food Chemicals Codex (1972) has a monograph on cedar leaf oil".

The same reference lists the concentration of cedar leaf oil present in final products sold in the U.S. as follows:

%

	Soap	Detergent	Creams, Lotions	Perfume
Usual	0.01	0.001	0.005	0.2
Maximum	0.1	0.01	0.03	0.4

In the industry interviews, concern about health hazard was a general theme. The main point was that, because of thujone's toxicity record and present licensing attitudes in government, the perfumery industry is unresponsive to the use of formulations containing thujone. The industry is very sensitive to health issues. The motto would seem to be that when in doubt about the safety of a material, leave it out.

The danger of this attitude to a supplier to the industry is real. As an example, Givaudan had enjoyed a good market for 18 years for a synthetic musk, versalid. A researcher found the musk to be a neurotoxin in rats. Givaudan's market completely disappeared in 2-3 weeks (14) (41).

The following comments on health issues were picked up during the interviews:

(a) Ardor Ltd. (8)

- under the impression that thujone is coming under attack because of its toxicity.

(b) Biddle Sawyer Inc. (32)

- any producer of cedar leaf oil should be concerned about the toxicity of thujone, not only from the viewpoint of markets, but also for its effect on the work force in the oil distillation plant.

(c) Fritzsche, Dodge & Olcott Inc. (21)

- toxicity of thujone is a most serious problem.
- even though fragrances are not ingested, perfumers would be most unwilling to incorporate thujone into their formulations because of the threat of a future problem.
- merely an unfavorable rumour can destroy sales for something with as fragile a market image as a perfume.

(d) Givaudan Corp. (22)

- uses cedar leaf oil in some perfume formulations but alerts its customers of the oil's thujone content.
- thujone is a real "no-no" in the industry.
- it is rumoured to have caused skin sensitivity reactions.

(e) International Flavors and Fragrances Inc. (41)

- toxicity and/or skin sensitivity, whether real or imagined, is a serious factor to consider when introducing a new fragrance.
- almost impossible now to get a new product approved by government for large volume use.
- since thujone is a known poison, its presence in a formulation does not aid the approval process.
- unaware of any rumour about skin sensitivity problems with thujone.

(f) International Fragrance Association (IFRA) (37)

- involved in monitoring and affecting legislation on safety of fragrance ingredients.
- believe a raw material that is 90% thujone will not be used in consumer products, but might be permitted for use as a feedstock for organic synthesis.

(g) J. Manheimer Inc. (2)

- health aspects of thujone should be investigated thoroughly.
- only when it is evident that thujone will pass all regulatory constraints should work proceed on a B.C. facility.

(h) Proctor and Gamble Co. (28)

- major hurdle in getting acceptance of a new fragrance is compliance with safety testing procedure.
- this would be difficult with an oil high in thujone.

(i) Research Institute for Fragrance Materials (38)

- an industry research facility to test safety aspects of fragrance materials.
- not aware of any current concerns with thujone.

(j) Richardson-Vicks Inc. (10)

- not aware of any movement by government to ban materials containing thujone because of skin sensitivity.

(k) RJR Technical Co. (9)

- thujone could very well be a skin irritant.

- the perfumery industry is sensitive to such issues and will likely become self-policing.

- fate of Michigan produced wormwood is uncertain because of its thujone content. It can not be used in flavorants and now the O.S.H.A. (Office of Safety and Health Administration) might ban it because of their skin sensitivity tests.

G. Plantation Growing of Cedar for Oil Production

A possibility mentioned by proponents of a cedar leaf oil industry is the growing of cedar in B.C. in plantations; the intention being to lower the cost of harvesting brush for distillation. In fact, it has been said that the species grown might be eastern white cedar rather than western red cedar because of the formers's more shrub-like growth characteristics.

Based on experience at the Reynolds experimental farm at Avoca and experience with 2 year old spruce in Ontario, Dr. Lawrence estimated the break-even price for cedar leaf oil derived from plantation grown cedar brush would be approximately U.S. $22 per lb., or about the same as that derived from wild brush (5).

The assumptions used by Dr. Lawrence obviously affect the cost data. Lawrence's calculations are set forth in detail in a File Note (9).*

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* On file at the B.C. Science Council Office.

H. Cost of Upgrading Essential Oils

1. Redistillation

B.C. western red cedar leaf oil in this present study was assumed to contain 90% total thujone. An important question, when comparing the cost of thujone from other essential oils to that from western red cedar, is the cost of redistilling a lower thujone content oil to remove impurities.

Lawrence (9) has done a lot of pilot plant redistillation of oils at Avoca. Based on this experience, he estimates it costs U.S. 85 ¢ per lb. of oil to remove 10% of an impurity by distillation. This cost includes loss in weight, labor, fuel and depreciation. For example, if the feed oil to redistillation has a cost of $10 per lb., the cost of the redistilled product would be $10.85 per lb. This cost obviously varies with factors such as the volume of oil being treated. However, it is indicative of the order of magnitude of redistillation costs.

2. By-Product Credits

Lawrence doubts that substantial revenue can be derived from distillation by-products of western red cedar leaf oil. Based on the chemical assays provided, he judged that 3% of the "back ends" might be saleable. Based on experience at Avoca, he thought this fraction might sell for less than $1.00 per lb., or, if very clean, for $5 per lb. Berje buys this type of material from distillers. The "front ends" would have minor value. This fraction in turpentine distillation sells for 15 ¢ per lb.

In addition to the "back ends" the only saleable by-product might be manoyl oxide. Manheimer reportedly might buy this at about $15 per lb.

3. Cost of Chemical Synthesis Steps

In the synthesis of fragrances or flavors from a chemical feedstock, the maximum number of chemical steps that are economic is claimed to be two (9, 21). Fritzsche, Dodge and Olcott Inc. has some products that require 4 or 5 chemical steps, but these are simple ones, and ones with high yields (e.g., hydrogenation). A small manufacturer would be very limited as to the number of steps possible because of the inability to take by-product streams to other processes.

Lawrence (9) estimates, as a general rule, one chemical step is ideal; two are acceptable; three are not practical.

I. Other B.C. Needle Oils

The questionnaire solicited statements of possible interest in other needle oils and also of cedar wood oil that could be made in B.C. The results are summarized in Table 6.

Because the production of other oils was to be a later phase in a facility to make cedar leaf oil, little attention was paid to these oils in company interviews once it became evident there was little real interest in cedar leaf oil.

Comments made by the following four companies on the other needle oils are of interest:

(a) J. Manheimer Inc. (2)

- other needle oils potentially available in B.C. could have an interesting future.
- however, the volumes will never be large.
- in the M & B study, Manheimer obtained a trial order for 100 - 200 lb. of hemlock oil, but it was never supplied.

(b) PFW Division of Hercules Inc*.

- possible interest in all the oils.
- since they have not been regularly available in the past, their developmental use in formulae has not been possible - chicken and egg situation.

(c) Polarome Manufacturing Co. Inc. (27)

- more interested in purchasing balsam leaf oil from B.C. than cedar leaf oil.
- used principally in shampoos - a small but healthy market.
- required price: U.S. $10 - 11 per lb., FOB New York.
- a large order would be 1,000 lb. per year.
- a market of 2,000 - 3,000 lb. per year could likely be developed for western fir (Abies spp.) needle oil.

(d) Synfleur Div. of Nestle Co. Inc. (13)

- the only needle oil with potential which might be produced in B.C. is true fir needle oil.

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* See returned mail questionnaire.

TABLE 6. INTEREST IN OTHER B.C. NEEOLE OILS BASEO ON RESPONSES TO THE QUESTIONNAIRE

COMPANY	COUNTRY	NEEOLE OILS							WOOO OIL
		HEMLOCK	DOUGLAS FIR	BALSAM	LOOGEPOLE PINE	PONDEROSA PINE	ENGELMAN SPRUCE	YELLOW CEDAR	WESTERN REO CEOAR
Amway Corp. (1)	U.S.A.	✓	✓	✓	✓	✓	✓	✓	✓
Berje International (2)	U.S.A.	✓	✓	✓	✓	✓	✓	✓	✓
Bush, Boake, Allen Inc.	U.S.A.	✓	✓	✓					
Centflor Manufacturing Co. Ltd.	U.S.A.			✓					
Dragoco Gerberding and Co. GmBH (2)	W. Germany	✓	✓	✓	✓	✓	✓	✓	✓
Elias Fragrances Inc.	U.S.A.		✓			✓		✓	✓
Food Complex Co. Inc.	U.S.A.		✓	✓		✓		✓	✓
Fritzsche, Oodge & Olcott Inc.	U.S.A.	✓		✓				✓	
Fuerst, Oay Lawson Ltd. (2)	U.K.	✓	✓	✓	✓	✓	✓	✓	✓
Hoechst, AG (3)	W. Germany				✓	✓			
International Flavors & Fragrances Inc.	U.K.	✓		✓					
Paul Kaders, GmBH	W. Germany	✓	✓		✓	✓		✓	✓
J. Manheimer Inc.	U.S.A.	✓	✓	✓	✓	✓	✓	✓	✓
Medallion International Inc.	U.S.A.	✓	✓	✓			✓		✓
Parento Ltd.	Canada								✓
A.S. Patterson Co. Ltd. (2)	Canada	✓	✓	✓	✓	✓	✓	✓	✓
Perry Bros., Oivision of Mallinckrodt	U.S.A.	✓		✓					✓
PFW, Oivision of Hercules Inc. (2)	U.S.A.	✓	✓	✓	✓	✓	✓	✓	✓ (4)
Polarome Manufacturing Co. Inc.	U.S.A.			✓					✓
SCM Corp. (5)	U.S.A.	✓	✓	✓	✓	✓	✓	✓	✓
Shaw Mudge	U.S.A.	✓	✓	✓	✓	✓	✓	✓	✓
Synfleur; Oivision of Nestle Co.	U.S.A.	✓	✓	✓	✓	✓	✓	✓	
Vioryl SA	Greece	✓				✓			✓

1. interested only at U.S. $3-3.50 per lb.
2. possible interest; requires survey of company's clients; need samples to do this
3. interested at U.S. $2-2.50 per lb.
4. interested at U.S. $2-5 per lb.
5. interested at U.S. $0.50-1.00 per lb.

J. Summary, Conclusions and Recommendations

A questionnaire was sent to approximately 300 companies active in the essential oil industry - producers, users and brokers - to solicit interest in B.C. needle oils, in particular western red cedar leaf oil. Sales of cedar leaf oil for direct use and as a source of thujone, to be used as a chemical feedstock, were explored.

Sixty-three or 21% of the companies contacted responded. Of these, 41 expressed no interest; 22 some interest. The negative replies came mostly from users; the positive replies, from brokers/traders.

Those expressing interest in B.C. cedar leaf oil were contacted by telephone and/or visited on a field trip. To establish credibility for the project, companies contacted were told that some $600,000 had been spent by the Science Council, and the range of research activities were described. Generally, interest expressed in the questionnaire evaporated in the follow-up, usually over price. The brokers/dealers seemed interested in another source of commission revenue.

1. Specific Company Interest

After the interviews, four companies were still interested in the uniqueness of B.C. cedar leaf oil (for perfumery applications). In addition, two companies were still interested in the oil as a source of thujone. These six companies were:

	Suggested Consumption lb. per year	Primary Interest
Ciba-Geigy Corp. (USA)	?	thujone
Firmenich Inc. (USA)	1,000 - 20,000	oil
Langley-Smith & Co. (UK)	several tonnes	oil
Medallion International Inc. (USA)	2,000 - 10,000	oil
Soda Aromatics (Japan)	200 - 1,000	oil
SCM Corp. (USA)		thujone

The expressions of interest by Soda Aromatics and Langley-Smith were received too late for follow-up. Medallion is intrigued with the unique fragrance characteristic of the oil, but has stated the oil will have to sell for less than eastern cedar leaf oil to capture a market. Firmenich, Ciba-Geigy and SCM Corp. are interested in B.C. oil for research and development programs. Commercialization is probably at least 5 years away, if successful. SCM says its projected use has little hope of commerical success. Ciba-Geigy likely cannot support an oil price much in excess of $5-10 per lb. Firmenich says a price in the $20 per lb. range is acceptable in the early years, but a reduction would be expected as the B.C. plant increased output.

2. Cedar Leaf Oil

For B.C. cedar leaf oil to sell in any appreciable volume, it would have to take markets currently filled by eastern cedar leaf oil. This total market is estimated at approximately 100,000 to

120,000 lb. per year. The market is severely depressed with the industry running well below capacity. Inventory at the producer and user levels is excessive - 1 to 2 years supply. This depressed situation is expected to last for at least 2-3 years, if not longer.

No growth in demand of cedar leaf oil is forecast. Richardson-Vicks, who accounts for over half the world consumption in Vicks Vapo-Rub, forecasts no growth in their requirements. Growth potential in other applications is not evident.

If a plant were to be constructed in B.C. to produce cedar leaf oil, its sales in the initial years probably would not exceed 2,000-5,000 lb. per year. Co-production of other needle oils might add 1,000-2,000 lb. per year to this figure. Any growth in output of cedar leaf oil would depend on the results of basic research and development programs requiring at least 5-10 years before commercialization could occur. It is doubtful the output would exceed 10,000 lb. per year, in the foreseeable future.

To sell most of its output, the price would have to be 10-15% below that of eastern cedar leaf oil, currently U.S. $10-13 per lb., delivered New York, or approximately U.S. $8.50-$11.50 per lb. This is well below the estimated required selling price for B.C. oil of U.S. $21-$23 per lb. Any market penetration would be at the expense of existing eastern Canadian producers - hardly of overall benefit to Canada.

There have been numerous attempts, mostly in Quebec; to modernize and mechanize the production of cedar leaf oil. All have gone bankrupt. Consequently, should a plant be built in B.C. it should be by an individual on a "cottage industry" basis. The plant of Dominion Essential Oils Ltd., in Ontario should serve as a model. Dominion Essential Oils' facility is stated to have cost approximately $15,000 to construct (this compares with the $900,000 to $1,400,000 estimated for facilities in B.C. to produce 30,000 to 50,000 lb. per year, respectively). It reportedly can supply the total world demand. A B.C. facility would likely require government subsidy to cover the high cost of harvesting cedar brush.

3. Thujone and Derivatives

Other than a small (approximately 2,000 lb. per year) market, no demand was found for thujone.

No evidence of research into uses of thujone was uncovered except that by Ciba-Geigy and SCM - both years from any commercialized product.

The sale of B.C. cedar leaf oil as a source of thujone for chemical feedstock is unlikely. For volume applications, thujone would have to sell in the U.S. $2-$5 per lb. range. For high cost applications, should any develop, volume would be small and susceptible to replacement by thujone from other sources, such as

plant species that probably can be grown commercially at lower cost, e.g., armoise and Dalmatian sage.

4. Health Issues

Complicating the future of cedar leaf oil is the known toxicity of thujone. This might prevent products incorporating B.C. oil (80-90% thujone) from becoming licensed in the perfume field. Even if licensing could be achieved, the fragile nature of perfume markets and their susceptibility to rumour and bad press will make the industry reluctant to incorporate the oil in formulations.

5. Market Structure

Because of the close-knit nature of the essential oil industry and the important role of brokers/traders in it, a B.C. cedar leaf oil facility would be wise to market its productions through one of the New York brokers already active in eastern cedar leaf oil. A commission of perhaps 3-5% on the FOB New York prices would have to be paid. Because of the depressed market, it is unlikely a trader could be found who would buy the production for resale.

6. Recommendations

1. All work on the concept of a B.C. facility to produce cedar leaf oil should be terminated.

2. Research work on the chemistry of thujone should only be continued with the full awareness that commercialization is years away and that western red cedar leaf oil may not be the most economic source of thujone.

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17. File Note, F. Canonica, Elias Fragrance Inc., September 16, 1981.

18. File Note, R. Wardell, Firmenich Inc., October 30, 1981.

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20. File Note, T. Morris, Firmenich Inc., November 11, 1981.

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28. File Note, B. Corbett, Proctor and Gamble Co., September 17, 1981.

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43. Letter from B.J. Kane, SCM Corp., January 20, 1982.

APPENDICES

APPENDIX A

"HAND-OUT" OF SOME WORK ON CHEMICAL DERIVATIVES OF THUJONE

Including that of Dr. Kutney, U.B.C.

SOME THUJONE CHEMISTRY

FOR

PROJECT 80-69-550

MARKET SURVEY FOR CEDAR LEAF OIL

by

E.P. Swan

Forintek Canada Corp.

Western Laboratory

6620 N.W. Marine Drive

Vancouver, British Columbia

V6T 1X2

September, 1981

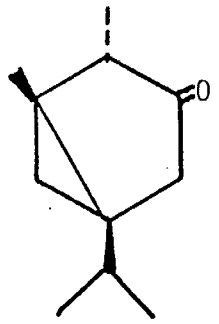
THUJONE

Introduction

The early work on western red cedar leaf oil showed that thujone was a major component (1,2). This was confirmed by von Rudloff (3) using modern GLC techniques. The yield of thujone has been in the 85-90 percent range (3,4,5). The ease of isolation of the oil, and the ease with which thujone can be obtained pure from the oil, together with the vast amounts of cedar leaf available are the reasons for this survey of thujone chemistry.

Early work

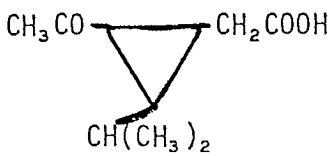
This work is taken from Simonsen (6). A summary of some representative reactions is given below. However, this work was performed without the benefit of modern spectroscopic techniques of product characterization. Also, the stereochemistry was imperfectly understood. The definitive study was performed by Bergqvist and Norin (7) and throughout the following discussion the stereochemistry 1 is implied.



1

a) Oxidation 1 →

Reagent	Product
dil. $KMnO_4$	2
dil. NaOBr	3
2 → dil. H_2SO_4	4
heat	5



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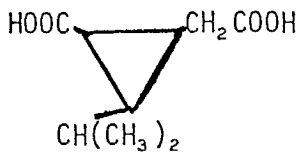

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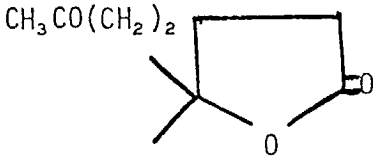

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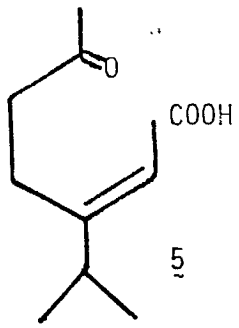
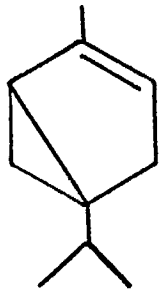


5

b) Reduction 1 →

Reagent	Product
NH_3, Hoffman	6, 7
Alcohol xanthate, Tschugaev	



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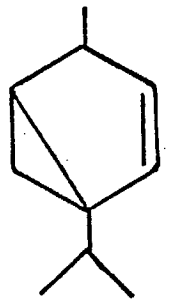
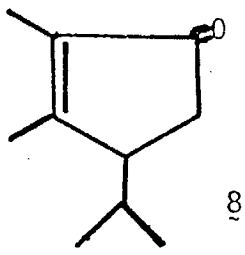


7

c) Acid 1 → 8

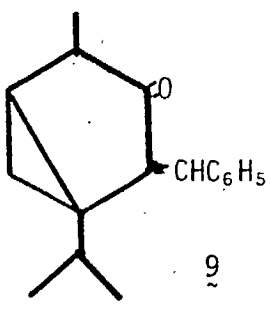
conc. H_2SO_4



8

d) Base 1 →

NaOEt, C_6H_5CHO aldol	9
HCOOR, Na	10



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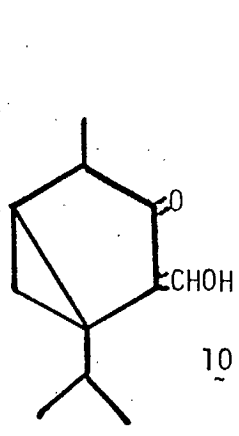


10

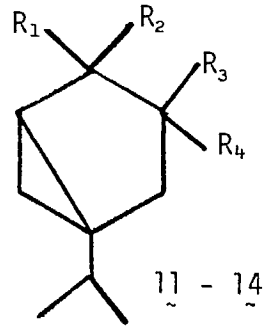
Modern Work

Similar examples to the above are given below, with appropriate literature citations in parentheses.

(a) Oxidation (7), 1 → 2 with aq. $KMnO_4$

Note that the western red cedar leaf oil was used as a starting material. It contained about 90 percent thujone and gave a 67 percent yield of 2 (α-thujaketonic acid).

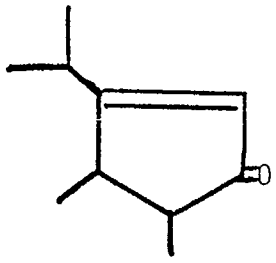
(b) Reduction (8), 1 → 11 - 14 with $H_2O/EtOH/NaBH_4$



11 - 14

	R_1	R_2	R_3	R_4
11	CH_3	H	OH	H
12	CH_3	H	H	OH
13	H	CH_3	OH	H
14	H	CH_3	H	OH

(c) Acid (9) 1 → 8, 15, 16 with H_2SO_4



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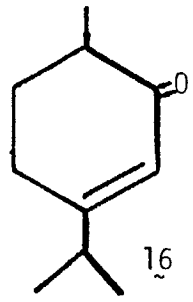
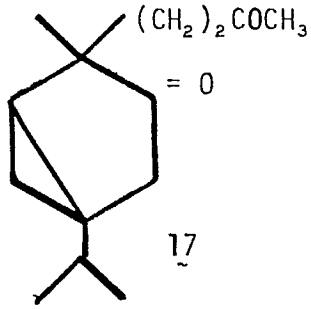


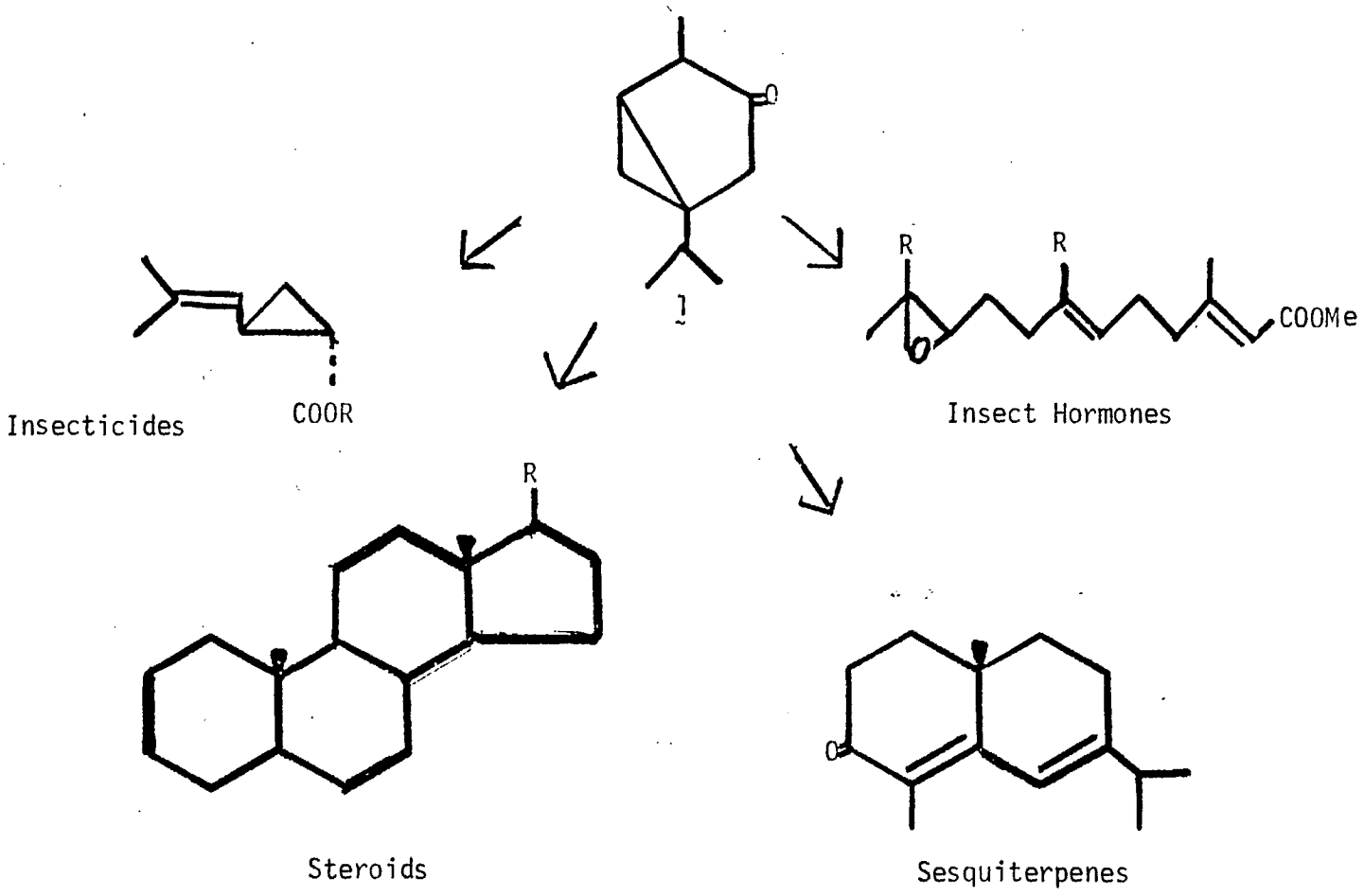
16

(d) Base (10) 1 → 17 with methyl vinyl ketone/KOH

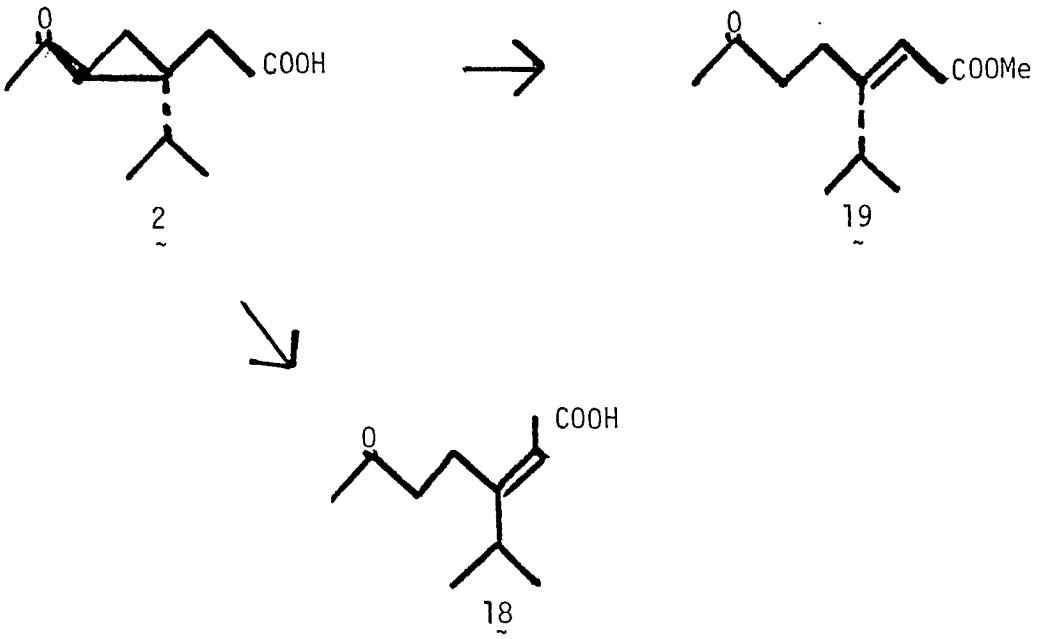


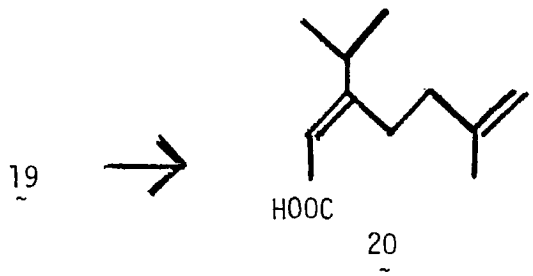
17

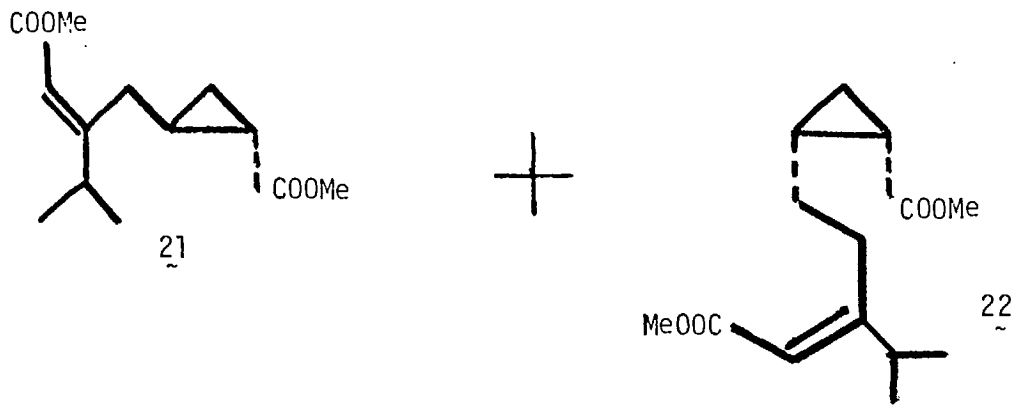
Applications The chemistry of thujone has been developed (7,10,11) for applications in the fields of insect chemistry, perfume chemistry, and pharmaceutical chemistry. Some highlights of these studies are given below.

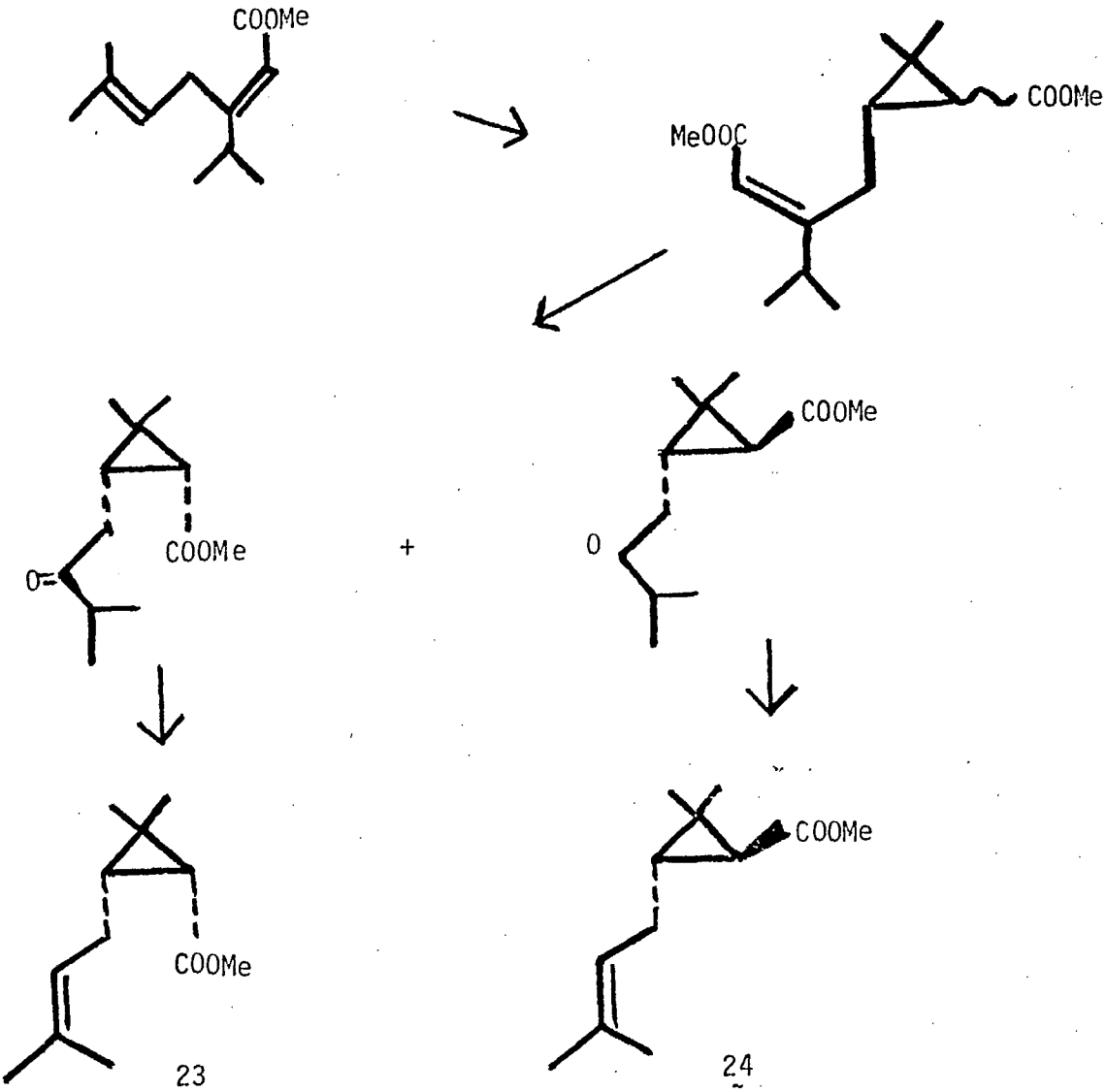


(a) Insect chemistry includes the novel pyrethroid analogues of these natural insecticides.


O
COOH
2
O
COOMe
19
COOH
O
18


19
HOOC
20


COOMe
COOMe
21
COOMe
MeOOC
22


COOMe
MeOOC
COOMe
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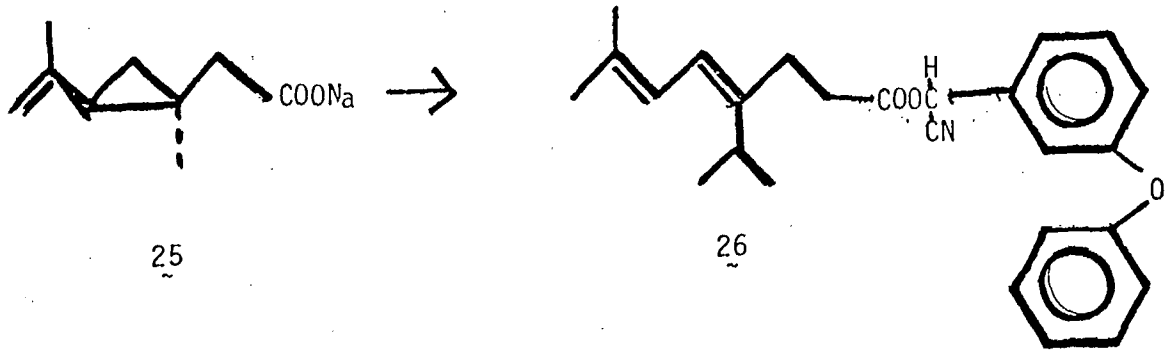
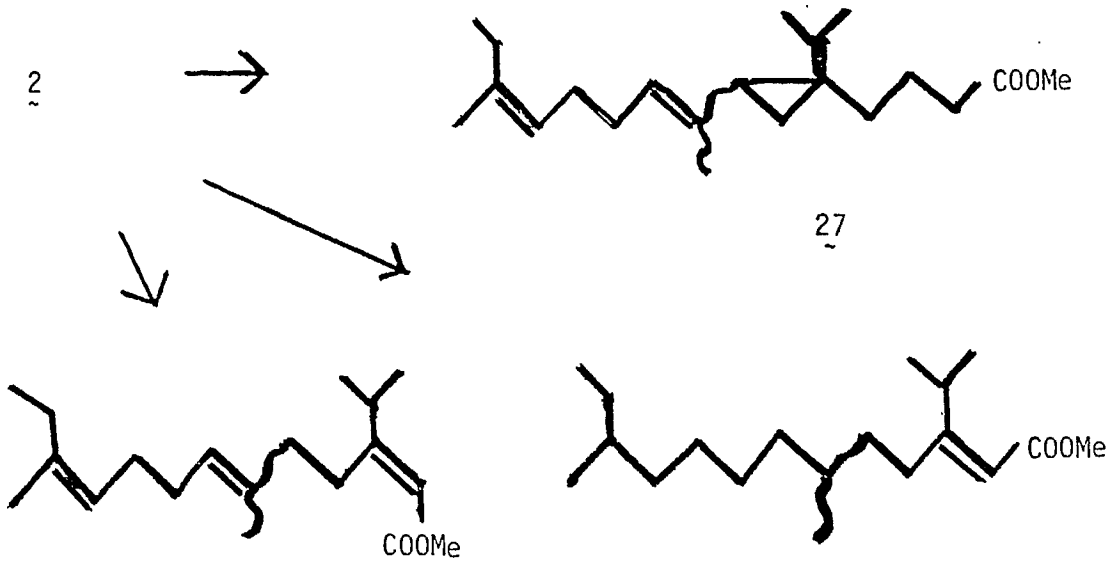
O=
+
COOMe
O
COOMe
COOMe

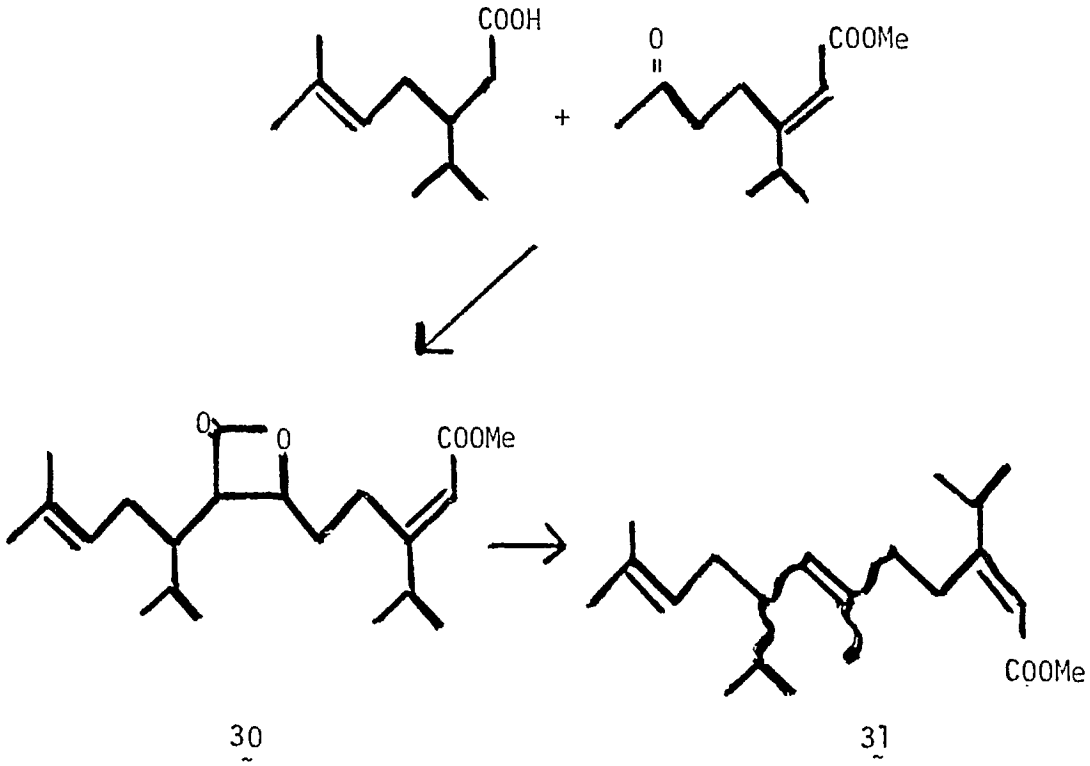
23 24

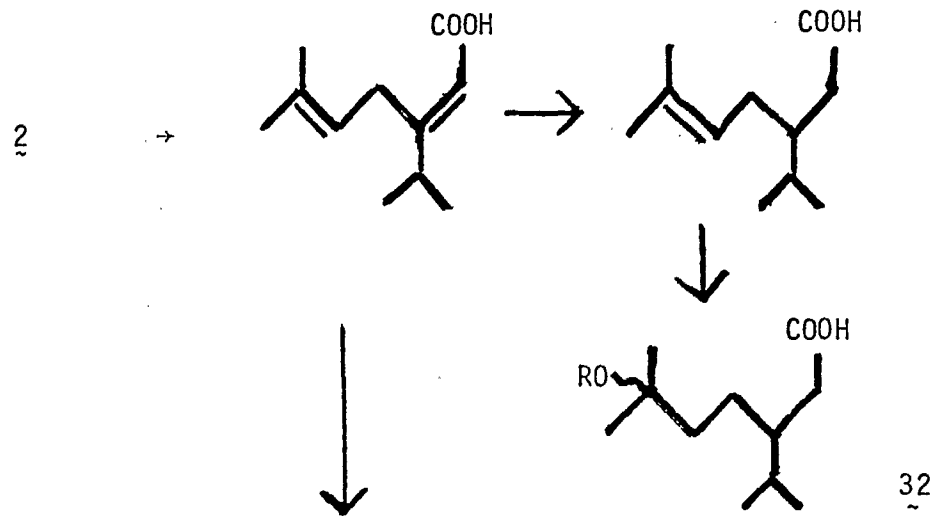

COONa
H
COOC
CN
O

25 26

Insect growth regulators prepared via Wittig reactions.







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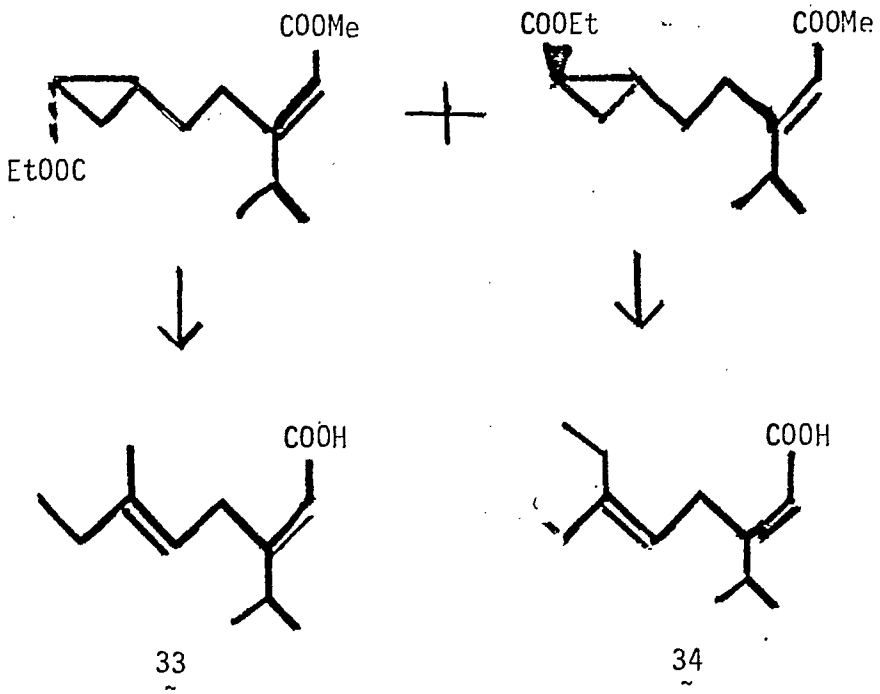

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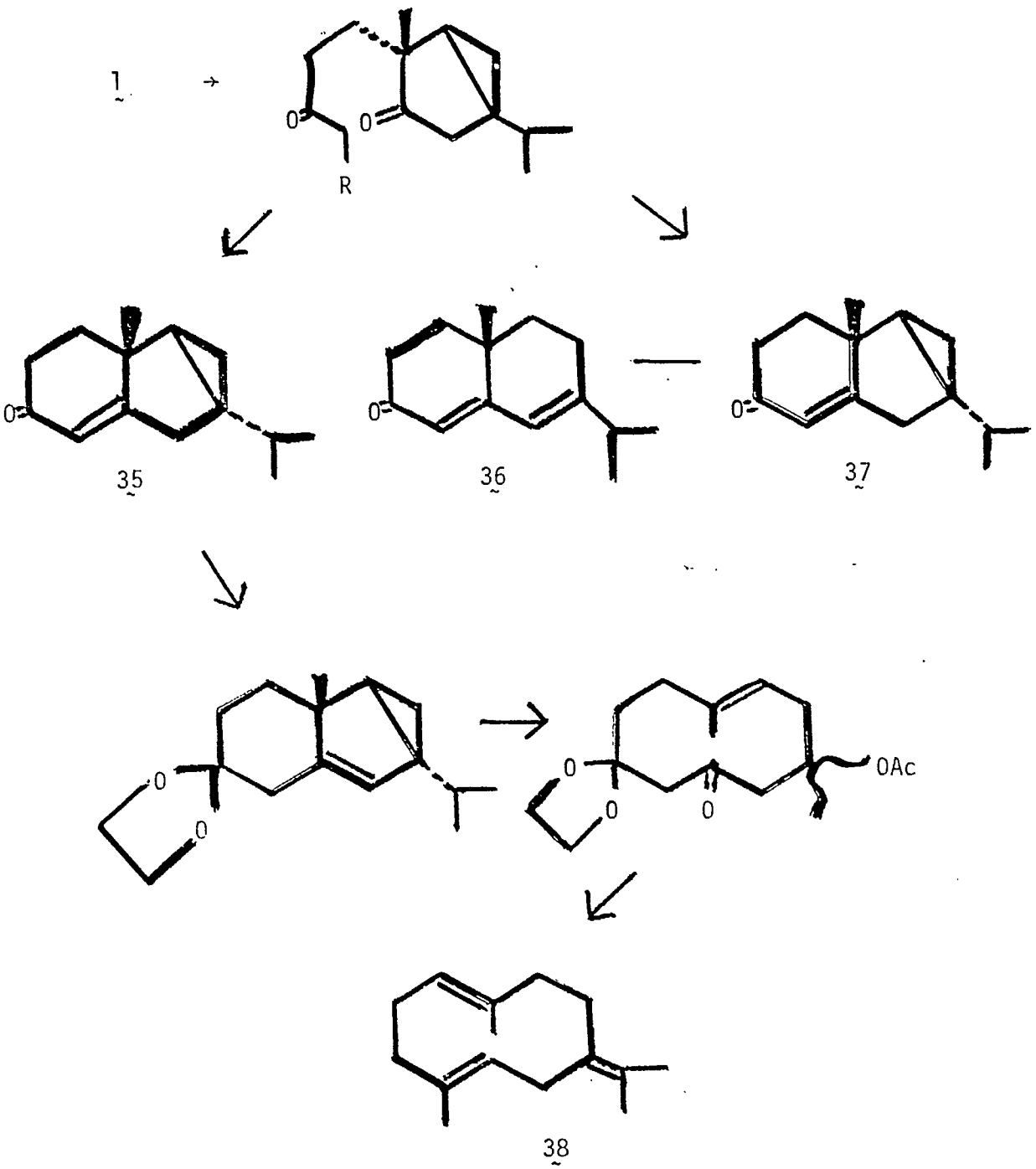
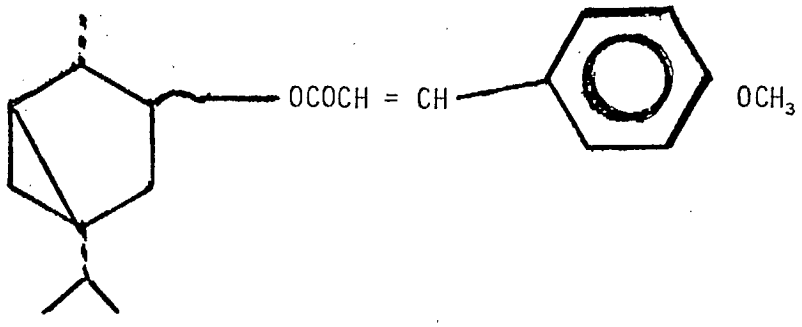
34

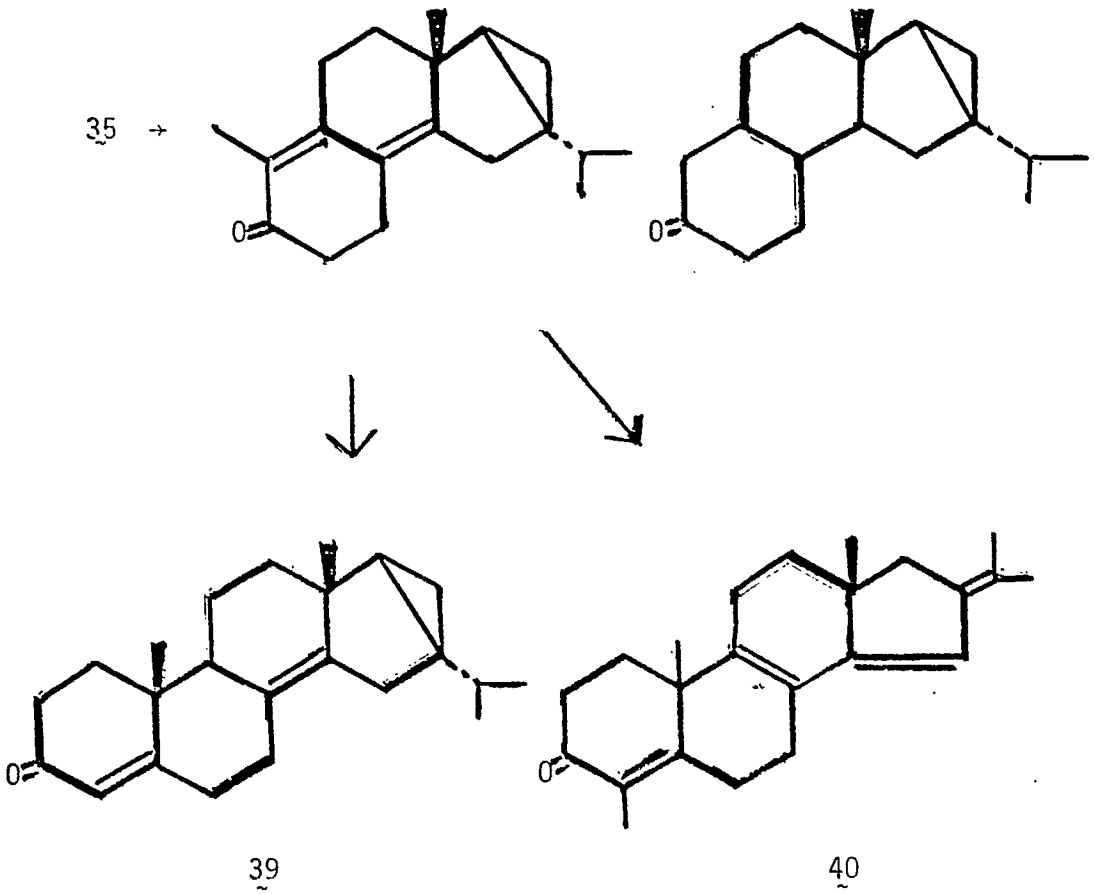
(b) Perfume chemistry includes the synthesis of sesquiterpenoid compounds:





Another derivative with promise was thujanyl cinnamate (12).

(c) Pharmaceutical chemistry could lead to analogues of the 19-nor-steroids, digitoxigenin and progesterone.



39 40

The field of thujone chemistry is rapidly expanding. For a more thorough discussion of this exciting work the reader should contact Prof. J.M. Kutney, Department of Chemistry, University of British Columbia, Vancouver, B.C.

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APPENDIX B

SAMPLE OF LETTER AND QUESTIONNAIRE

SENT TO THE ESSENTIAL OIL INDUSTRY

July 14, 1981

We have been engaged by the governments of British Columbia and Canada to conduct a market survey for western red cedar leaf oil - a product not now available commercially. This market survey is part of a detailed feasibility study for production in British Columbia. Concurrent with the market study, a collecting and distillation system is being engineered and costed. The design is based on a pilot plant campaign conducted last year.

For several years a significant laboratory program has been financed at the University of British Columbia on the chemistry of western red cedar leaf oil and its use as a chemical building block for making products applicable to the perfumery, toiletry and insecticide industries. This work has shown promise and is continuing.

Two broad markets are seen for western red cedar leaf oil:

1) direct use in perfumery, pharmaceutical and toiletry applications;

2) use as a chemical building block based on its high thujone content.

The market survey is being done in two steps. This first uses the attached questionnaire to canvass the general industry. In the second step, direct visits and follow-up interviews of interested companies will be conducted.

A brief description of western red cedar leaf oil and comparison with eastern cedar leaf oil are given in Attachment A. Past work with the oil has indicated it possesses a unique, herbal fragrance. Its other interesting property is the high thujone content - up to 90% in the raw oil.

The proposed production scheme visuals a distillation plant based on an adjacent western red cedar plantation. Foliage from thinning operations would be collected and trucked to the distillation plant. A side benefit would be removal of a forest fire hazard. The forests of B.C. could support on a sustained basis roughly 20 collection/distillation operations each with a maximum annual capacity of approximately 50,000 kg (110,000 lbs). Consequently, if markets are available, a total annual production of up to 1,000,000 kg (2,200,000 lbs) could be visualized.

The price required for the oil would depend on volume, but calculations to date indicate a selling price in the range of $33-44 (U.S.) per kg ($15-20 (U.S.) per lb) will be required. If warranted, production of oil could start in 1983.

. . . 2

July 14, 1981

We would appreciate your organization taking the time to answer and return the attached questionnaire. If you would like more information and/or a follow-up discussion, we will be in touch with you as soon as possible.

The questionnaire contains a question directed toward other potential B.C. leaf oils. These could readily be made in the same facilities as proposed for western red cedar leaf oil. In addition, oil from western red cedar wood is included. This oil could be a source of methyl thujate, thujic acid and the thujaplicins. These oils are described in Attachment B.

Thank you for your trouble.

Yours truly,

E.P. Swan
Research Scientist
Wood Science Department

Encl.

ATTACHMENT A

Western Red Cedar Leaf Oil

The leaf oil from the western red cedar tree (*Thuja plicata*) is obtained in 1-4 percent yield by steam distillation of fresh leaves. The oil has a fresher and pleasanter odour than that from its closest relative eastern white cedar leaf oil. Eastern cedar leaf oil has been an article of commerce for many years.

The composition of western red cedar leaf oil indicates about 90 percent of it is the monoterpene ketone thujone. Various other terpene hydrocarbons make up about 5 percent. Table A-1 compares the composition of the eastern and the western leaf oils.

TABLE A-1

Comparison of the Cedar Leaf Oils[a]

Compound	Percent[b] Present	
	Eastern	Western
α-pinene	1.3	1.0
α-fenchene	0.8	-
camphene	1.2	-
sabine	1.8	2.0
myrcene	0.5	0.6
limonene	0.9	0.4
p-cymene	1.4	0.9
fenchone	14.0	-
thujone*	60.0	89.0
isothujone	9.5	0.4
camphor	1.9	-
terpenen-4-ol	1.2	-
bornyl acetate	2.2	2.0
isoborneol	-	0.8

[a]Only compounds present in greater than 0.4 percent amounts are given.

[b]The total does not sum to 100 percent because of many other terpenes present in amounts less than 0.4 percent.

*Major component.

ATTACHMENT B

Other B.C. Conifer Leaf Oils

The collection of western red cedar leaf also allows other species' leaves or needles to be collected. These species grow with western red cedar, so their leaf oil composition has also been studied. These species are the following: amabilis fir, Douglas-fir, Engelmann spruce, lodgepole and ponderosa pines, western hemlock, and yellow cedar.

Table B-1 shows the leaf oil composition of these species, going from the major to the minor components. Usually these are monoterpenes which have been used commercially for years.

The recovery of oil from western red cedar heartwood can also be readily achieved in British Columbia. Its composition is also given in Table B-1.

TABLE B-1

Components of Other B.C. Oils

Species	Compounds Major to Minor
1. Amabilis fir needles	β-Phellandrene, Δ-3-carene pinenes (α, β) myrcene
2. Douglas-fir (Interior) needles	Camphene, bornyl acetate, pinenes (α, β), limonene
3. Engelmann spruce needles	Pinenes (α, β), myrcene, camphene, camphor
4. Lodgepole pine needles	β-Phellandrene, pinenes (α, β) Δ-3-carene, myrcene
5. Ponderosa pine needles	Pinenes (α, β), Δ-3-carene, α-terpineol, estragole
6. Western hemlock needles	β-Phellandrene, pinenes (α, β) myrcene, α-phellandrene
7. Yellow cedar needles	Curcumes (α, β, γ), α-pinene, Δ-3-carene, limonene
8. Western red cedar heartwood	Methyl thujate, thujic acid, thujaplicins (β, γ, and 7-OH)

QUESTIONNAIRE

MARKET OUTLOOK FOR BRITISH COLUMBIA ESSENTIAL OILS

COMPANY: _____

ADDRESS: _____

_____

TELEPHONE: _____

NAME AND TITLE: _____

TYPE OF BUSINESS

ESSENTIAL OIL PRODUCER ☐

ESSENTIAL OIL BROKER ☐

ESSENTIAL OIL CONSUMER ☐

PERFUMES ☐ ; TOILETRIES ☐ ; OTHER ☐

MANUFACTURER OF ARTIFICIAL AROMAS AND FLAVORS ☐

A. WESTERN RED CEDAR LEAF OIL

1. Are you interested in purchasing Western Red Cedar Leaf Oil?

   Yes ☐ ; No ☐

2. If not, reason:

   a. No application for such an oil ☐

   b. Proposed price of U.S. $15-20/lb. too high ☐

      Required price range for interest: U.S. $ _____ per lb.

   c. Other ☐

      Comment:

3. Your interest in this oil is for: ☑

	Yes	No
a. Resale to third parties	___	___
b. Direct use in perfumes and toiletries	___	___
c. Use as chemical feedstock	___	___

4. Rough estimate on annual quantity that might be required:

   _____ kg per year.

B. OTHER OILS

1. Are you interested in any of the following oils that could be made in British Columbia (see Attachment B)?

✓	Yes	No	Price required to be of interest
Leaf Oils			
Hemlock	___	___	___________
Douglas-fir	___	___	___________
Balsam	___	___	___________
Lodgepole Pine	___	___	___________
Ponderosa Pine	___	___	___________
Engelmann Spruce	___	___	___________
Yellow Cedar	___	___	___________
Wood Oils			
Western Red Cedar	___	___	___________

C. CONTACT FOR FOLLOW-UP INTERVIEWS

NAME: ______________________________

TITLE: ______________________________

ADDRESS: ______________________________

____

Date: ____________________

APPENDIX C

LIST OF PERFUMERY AND ESSENTIAL OIL TRADE ASSOCIATIONS AND CANADIAN TRADE COMMISSION OFFICES CONTACTED

1. COPY OF LETTER SENT TO CANADIAN CONSULATES

WITH ATTACHED MAILING LIST

June 12, 1981

80-69-550

We have been engaged by the Science Council of British Columbia to conduct a market survey for cedar leaf oil. This is part of a detailed feasibility study of the production in B.C. of oil from western red cedar foliage.

This oil is not currently produced and we believe represents a new raw material for the perfumery, toiletries and flavouring industries. In addition, because of the composition of the raw oil, approximately 90% thujone, there is expectation that the oil could serve as a building block for use in the organic chemical industry. Experimental work in B.C. has shown the thujone can be converted into intermediates in perfumery, pharmaceutical and insecticide applications, as well as for use in flavours and toiletries.

The market study is being paid for jointly by the B.C. and Canadian governments and will be done in two parts. In the first, we will do a mail survey with a questionnaire to contact as wide a number of companies in the field as possible. The questionnaire will attempt to establish interest of each company in the oil and to choose a short list for field visits. We wish to get the questionnaire into the mail in July and conduct the field visits in September.

We would appreciate from your office any list of companies you feel it would be worth contacting in your jurisdiction. Any statistical information on production, consumption, end-use patterns, imports, exports and prices of essential oils that you could provide would be greatly appreciated as well.

Thank you.

Yours truly,

H.N. Halvorson

cc: Dr. E.P. Swan
Mr. M. Cairns

1. R. Spruyt
   Commercial Officer
   Commercial Division
   Canadian Embassy
   rue de Loxum 6
   B-1000 Brussels
   Belgium

2. J. Mercer
   Commercial Division
   Canadian High Commission
   One Grosvenor Square
   London, W1X 0AB
   England

3. Jean Besnard
   Commercial Officer
   Commercial Division,
   Canadian Embassy
   35 Avenue Montaigne
   75008 Paris,
   France

4. D. Alberts
   Marketing Officer
   Canadian Consulate General
   Esplanade 41-47
   2000 Hamburg 36
   West Germany

5. Y.T. Lee
   Chief Manager
   Commercial Division
   Commission for Canada
   14/15 Floors Asian House
   1 Hennessy Road,
   P. O. Box 20264
   Hong Kong, Hong Kong

6. M. McDermott
   Commercial Officer
   Commercial Division
   Canadian Embassy
   Via G.B. de Rossi 27
   00161 Rome
   Italy

7. Miss M. Huber
   First Secretary (Commercial)
   Commercial Division
   Embassy of Canada
   3-38 Akasaka 7 - Chome, Minato-ku
   Tokyo 107, Japan

8. F.W. Zechner
Commercial Officer
Commercial Division
Canadian Embassy
Sophialaan 7,
2514 JP The Haque,
The Netherlands

9. Vincent Wong
Commercial Division
Canadian High Commission
P. O. Box 845
Faber House, 7 and 8th Floors
230/236 Orchard Road,
Singapore 9, Singapore

10. Mr. M. Meister
Commercial Officer
Commercial Division
Canadian Embassy
Kirchenfeldstrasse 88
3006 Berne
Switzerland

11. Miss A. Holden
Commercial Officer
Commercial Division
One Maritime Plaza
San Francisco, CA. 94111

2. COPY OF LETTER SENT TO INDUSTRY ASSOCIATIONS

WITH ATTACHED MAILING LIST

Forintek Canada Corp.
6620 N.W. Marine Drive, Vancouver, B.C. V6T 1X2 Telephone (604) 224-3221 Telex 04-508552
Western Laboratory

June 12, 1981

80-69-550

We have been engaged by the Science Council of British Columbia to conduct a market survey for cedar leaf oil. This is part of a concerted feasibility study of the production in B.C. of oil from western red cedar foliage. This would be a new oil for use by your industry.

The raw oil contains about 90% thujone and is quite distinct from other cedar leaf oil currently being produced. The B.C. oil should find use in perfumery, flavouring and toiletries. In addition, because of its purity, the oil can be used as a direct building block for use in the organic chemical industry. Experimental work in B.C. has shown the thujone can be converted into intermediates in perfume, pharmaceuticals and insecticide applications, as well as in flavours and toiletries.

To aid in the market survey a membership list for your organization would be appreciated, as would general information on the association.

Could you please provide the names of your members that you judge would be most likely to be interested in learning more about this oil and in being contacted on a field trip planned for September.

Do you collect statistical information on the consumption of essential oils by your members? Any such information would be helpful.

Yours truly,

E.P. Swan
Research Scientist
Wood Science Department

cc: Dr. H.N. Halvorson ✓
Mr. M. Cairns

U.S.A.

1. Fragrance Foundation
   c/o Miss Annette Green
   116 E. 19th Street,
   New York, N.Y.
   10003 U.S.A.

2. Cosmetic Industry Buyers and Supplies
   c/o Mr. H.W. Varrichio
   Kristin Packaging Inc.,
   P. O. Box 712
   Syossett, N.Y.
   11791 U.S.A.

3.* Cosmetic, Toiletry and Fragrance Association, Inc.,
   c/o K.L. Moore, Executive Assistant
   1110 Vermont Avenue, N.W.
   Washington, D.C.
   20005 U.S.A.

4.* Essential Oil Association of U.S.A., Inc.
   Disbanded in 1980; used 1979 Membership List

EUROPE

1.* Brancheforeningen for Saebe - Parfumeri - Toilet-og
   Kemisk - Tekniske Artikler
   c/o Mr. Wivel
   Ostergade 22,
   DK-1100 Kobenhavn K
   Denmark

2.* Essens Fabrikant Foreningen
   Grabodretorv 16,
   DK-1154 Kobenhavn K
   Denmark

3.* Teknokemian Yhdistys r.y.
   c/o K. Svensson
   Fabianinkatu 7B
   00130 Helsinki 13
   Finland

4. Federation Française de l'Industrié
   des Produits de Parfumerie, Beaute
   et de Toilette
   8 Place du Général - Catroux
   75017 Paris,
   France

5. Syndicat des Fabricants de Produits
Capillaires, d'Hygiène, de Beauté et de Matières
Premières Cosmétiques
4 rue des Petits- Champs
75002, Paris
France

6.* Federation Francaise des Syndicats de l'Aromatique
c/o Mr. P. Vigne
7, rue Gazan
06130 Grasse,
France

7.* Federation Francaise des Syndicats de l'Aromatique
c/o Mr. F.C. Guglielmina
Scientific Officer,
57, avenue Marceau
75116 Paris,
France

8. Panellinios Enosis Viomichanon kai
Viotechnon Ellinikon
Kalluntikon kai Kallopistikon Proionton
Leof. Mesogeion 351
Ag. Paraskeon
Athinai,
Greece

9. Pannellinois Syndesmos Viomichanon kai
Antiprospopon Kalluntikon kai Aromaton
Akadimias 28
Athinai 134
Greece

10. Unione Nazionale delle Industrie di Profumeria,
Cosmesi, Saponi da Toelette e Raffini
Via Buonarroti 38
20145 Milano
Italy

11.* Vereniging van Nederlandse Aroma-en Reuksloffenen - dustrien
c/o L. van Eek
Javastraat 2,
2585 Am's - gravenhage
Netherlands

12.* Kosmetikkleverandorenes Forening
c/o Miss I. Standal
Boks 6780
St. Olavs plass 3
Oslo,
Norway

13. Associacao dos Industriais de Cosmetica
Rue Rosa Araujo 49-B-2°
1200 Lisboa
Portugal

14.* Asociacion Nacional de Fabricantes
de Perfumeria y Afines
c/o Mr. G.F. Hervada, Director
San Bernardo 23.2.
Madrid 8,
Spain

15. Kemisk - Tekniska Leverantorsforbundet
Hollandgatan 23
Box 1542
11185 Stockholm
Sweden

16. Svergies Kemisk - Tekniska Leverantorforening
Grevgaton 34
Box 5512
11485 Stockholm
Sweden

17.* Foringen Svenska Aromtillverkare
c/o K. Lindahl
Storgatan 19
Box 5501
11485 Stockholm 5
Sweden

18. Association Suisse des Fournisseurs des Produits
Cosmetiques, Pharmaceutiques et d'Article Apparantes
Stadelhoferstrasse 40
8024 Zurich
Switzerland

19.* International Fragrance Association (IFRA)
c/o Dr. F. Grundschober
8, rue Charles-Humbert
CH-1205 Geneva
Switzerland

20. Industrieverband Korperflege
und Waschmittel eV
6000 Frankfurt/Main
Karlstrasse 21
West Germany

21.* Verband der Deutschen Essenzenindustrie E.V.
c/o Mr. H.-E. Muermann
Meekenheimer Allee 87,
5300 Bonn,
West Germany

22.* Verband Deutschir Riechstoff-Fabriken
c/o Dr. W. Eicke
Meekenheimer Allee 87,
5300 Bonn 1
West Germany

* Responded to the enquiry.

APPENDIX D

LIST OF COMPANIES SENT THE QUESTIONNAIRE AND THEIR RESPONSES

CANADIAN COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
Avon Canada Inc.	5500 Trans Canada Hwy., Pointe Claire, P.Q. H9R 1B6	Roger Bourque	- no interest - no application - user (Toiletries)
BDH Chemicals Canada Ltd.	6730 Cote de Liesse, St. Laurent, Quebec H4T 1A3	Manager	- no reply
Botanicus Inc.	#101 - 310 Victoria Ave., Montreal, Quebec H3Z 2M9	Bob Stecko	- no reply
Bush, Boake, Allen Corp. Ltd.	312 Rue St. Patrick, La Salle, Quebec H8N 2H2	Manager	- no reply - See Bush, Boake Allen U.S.A. & UK
Chemsolve Ltd.	505 Consummers Rd., Willowdale, Ontario M2J 4V8	Manager	- no reply
Frank E. Dempsey & Sons Ltd.	47 Davies Ave. Toronto, Ontario M4M 2B1	Manager	- no reply
Dominion Essential Oils Co.	Bancroft, Ontario K0L 1C0	Mr. Brown President	- no reply
Felton International Inc.	601 Garyray Dr., Weston, Ontario M9L 1P9	Manager	- no reply - See Felton Int. USA
Florasynth (Canada) Ltd.	4667 Hickmore, St. Laurent, Quebec H4T 1K5	R. Arsenault	- no interest - no application - too expensive - telephoned - M&B contacted - no interest - see U.S.A co.
Fries & Fries Div. of Mallinckrodt Can. Ltd	3610 Mashua Dr., Mississauga, Ont. L4V 1M9	Manager	- no reply see Fries & Fries USA
Fritzsche Dodge & Olcott Can.	50 North Wind Place, Scarboro, Ontario M1S 3R9	Manager	- no reply - see USA company
Givaudan Ltd.	4131 Sherbrooke W., Montreal, Quebec H3Z 1B7	Manager	- no reply - see USA company
Henderson DW Products Ltd.	199 Fairview Drive, SE Calgary, Alberta T2H 1B4	Manager	- no reply

CANADIAN COMPANIES cont'd

COMPANY	ADDRESS	CONTACT	COMMENTS
Henkel Chemicals (Canada) Ltd.	9550 Ray Lawson Blvd., Ville D'Anjou, Quebec H1J 1L3	G. Hermelink Man. Tech. Services	- no interest - no application - see Henkel U.S.A. - see Henkel, W. Germany
International Flavours & Fragrances (Can) Limited.	7330 Keele St., Concord, Ontario L4K 1B1	Manager	- no reply - see IFF, U.S.A.
Monsanto (Can) Ltd.	2000 Argentia Rd. Plaza 2, P.O. Box 787, Mississauga,Ont.	Manager	- no reply - see Mansanto Ind. Chem. USA - see Mansanto Ltd. U.K.
Naarden Can.	561 Orly, Dorval, Quebec H9P 1E9	Manager	- no reply - see Naarden Int. USA Inc.
Norda International Ltd.	833 King W. Toronto, Ontario M5V 1N9	Manager	- no reply - see Norda Inc. USA
Parento Co.	70 Mack Ave., Scarborough, Ontario M1L 1N1	Manager	- may be interested - user (perfumes)
A.S. Paterson Co. Ltd.	2347 Yonge St. Toronto, Ontario M4P 2C8	Manager	- interested, broker
PFW Frutal Sales Co. Ltd.	5285 Creekbank Rd., Mississauga, Ontario L4W 1N3	Manager	- no reply - see PFW, Hercules Inc. USA
Richardson-Merrel (Canada) Ltd.	2 Norelco Drive, Weston, Ontario M9L 2X6	Manager	- no reply see Richardson Vicks U.S.A.
Universal Flavors (Can)	3911 M. Lehman Rd., Abbotsford, B.C. V2S 4N3	Manager	- no reply - see Universal Flavor USA
Universal Flavors (Can)	110 Vulcan, Rexdale, Ontario M9W 1L2	Manager	- no reply - see Universal Flavor USA

UNITED KINGDOM COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
Albright and Wilson	Albright & Wilson House, P.O. Box 3, Hagley Road West, Oldbury, Warley B68 ONN	Manager	- no reply
Allmey & Layfield Ltd.	1 Holden Street, Liverpool L8 7RF	Manager	- no reply
Atlas Chemical Ind. (UK)	Cleeve Rd. Leatherhead, Surrey KT22 7SW	M. Shirley Purchasing manager	- no interest - no application - user(Surfactants)
Barnett & Foster Ltd.	Denington Estate, Wellingborough, Northants NN8 2QJ	Manager	- no reply
Beecham House,	Great West Rd., Brentford TW8 9BD	Manager	- no reply
Bestoval Products Co. Ltd.	2A Ossary Rd. London SE1 5AW	Manager	- no reply
BOC International Ltd.	Hammersmith House, London W6 90X	Manager	- no reply
The Boots Co. Ltd.,	Nottingham, Nottinghamshire NG2 3AA	Manager	- no reply
British Celanese Ltd.	P. O. Box 5, Spondon Derby DE2 7BP	Manager	- no reply - see Celanese Corp., U.S.A.
Bush Boake Allen Ltd.	Blackhorse Lane, Walthamston, London E17 5QP	Manager	- no reply - produces aromatics from pinene - see Bush Boake Allen Inc. U.S.A. - contacted by telex
Clayton and Jowett Ltd.	46 Wood St., Liverpool L14 AH	Manager	- no reply
Croxton and Garry Ltd.	Curtis Rd., Dorking, Surrey RH4 1XA	Manager	- no reply
H.E. Daniel Ltd.	Longfield Rd. Royal Tunbridge Wells, Kent TN2 3EY	E.J. Myerson Technical Director	- no interest - user (artifical aromas and fragrances)

UNITED KINGDOM COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
Duckworth & Bevan Ltd.	Chester Rd., Old Trafford, Manchester M16 9HJ	Manager	- no reply
Firmenich and Co. Ltd.	Hayes Rd., Southall Middlesex UB2 5NN	Manager	- no reply, see Firmenich USA
Fisons Ltd.	Fison House, 9 Grosvener St., London W1X OAH	Manager	- no reply
Florasynth Ltd.	327/347 Oldfield Lane, Greenford, Middlesex, UB7 OAH	Manager	- no reply - see Floraynth Canada Ltd.
Food Industries Ltd.	Bromborough Port, Wirral, Merseyside L62 4SU	Manager	- no reply
Fritzsche Dodge & Olcott (UK)	Finedon Rd. Industrial Estate, Links Rd. Wellingborough, Northants NN8 4DB	Manager	- no reply - see Fritzsche Dodge & Olcott Inc. USA
Fuerst Day Lawson Ltd.	1 Leadenhall St., London EC3V 1JH	Manager	- interested - broker - interest in other oil
Glaxo Holdings Ltd.	Clarges House, 6-12 Clarges St., London W1Y 8OH	Manager	- no reply
Glentham Essence Co. Ltd.	Twickenham Trading Estate, Rugby Rd., Twickenham, Middlesex TW1 1DQ	Manager	- no reply
F. Gutkind & Co. Ltd.	Chansitor House, 37/38 Chancery Lane, London WC2A 1EL	Manager	- no reply
T. Harrison & Co. Ltd.	Burnley House, 3 Burnley Rd., Willesden, London, NW10 1DY	Manager	- no reply
Hercules Ltd.	20 Red Lion St., London, WC1 R4PB	Manager	- no reply, see PFW Div. Hercules, USA; see Langley-Smith and Co. Ltd., UK
Imperial Chemical Industries	Imperial Chemical House, Millbank London SW1P 3JF	Manager	- no reply, see ICI American, USA

UNITED KINGDOM COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
John Kellys (London) Ltd.	Prescot House, Prescot St. London E1 8BB	H.F. Astor	- no reply
Langley-Smith and Co. Ltd.	19-21 Christopher St., Finsbury Square, London EC2A 2BT	P.W. Cowper	- interested; several tonnes per year; see Hercules Ltd. UK
Lautier Aromatiques Ltd.	Power Rd., Chiswick, London W4 5PJ	Manager	- no reply - see Rhone-Poulenx USA & FRANCE
Monsanto Ltd.	10-18 Victoria Street, London SW1 ONQ	Manager	- no reply - see Monsanto Industrial Chemicals Co. USA
Munton and Fison Ltd.	Cedars Factory, Stowmarket, Suffolk 1P14 2AG	Manager	- no reply
Pointing Ltd.	Prudhoe, Northumberland NE 42 6NJ	Manager	- no reply
Proctor and Gamble Ltd.	P.O. Box 9, Hayes - Gate House, 27 Uxbridge Rd., Hayes, Middlesex UB4OJD	Manager	- no reply - see Proctor and and Gamble U.S.A.
Reckitt - Colman, Industrial Div.	P.O. Box 20 Cressex Estate, High Wycombe, Buckinghamshire HP12	Manager	- no reply
Roche Products Ltd.	318 High St. North, Dunstable, Beds LV6 1EG	J.E. Packham Export Manager	- no interest - no application - Givaudan Corp. USA
S & S Services Ltd.	Abford House, 15 Wilton Road. London SW1V 1NE	Manager	- no reply
Semons, Taylor (UK) Co. Ltd.	Wildmere Rd. Banbury, Oxon OX16 7UK	Manager	- no reply
RC Treatt & Co. Ltd.	Northern Way, Bury St. Edmonds, Suffolk P32 6N6	Manager	- no reply

UNITED KINGDOM COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
Unilever Ltd.	Unilever House, London ED4P 4BQ	Manager	- no reply - see Lever Bros. U.S.A.
Universal Flavours (UK) Ltd.	7 Brick Knoll Park, Ashley Rd., St. Albans, Herts AL15UQ	Manager	- no reply - see Universal Flavor Corp. USA
Wellcome Foundation Ltd.	P.O. Box 129 The Wellcome Building, 183 Euston Rd. London NW1 2BP	Manager	- no reply
Wynmouth Lehr and Fatoch Ltd.	158 City Rd., London EC1v 2PA	Manager	- no reply
Zimmerman Hobbs Ltd.	Dawson Rd., Bletchley, Milton Keynes, Bucks MK1 1JR	Manager	- no reply

WESTERN EUROPEAN COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
Belgium			
Solvay and Cie SA	B-1050 Bruxelles, Rue du Prince Albert 33	Manager	- no reply
France			
L'Oreal	14 rue Royal, 75008 Paris 8E	Manager	- no reply
CDF Chimie SA	Tour Aurore Courbevoie, Cedex no. 5 92080 Paris La Defence 2	Manager	- no reply
Payan and Bertrand SA	Avenue Jean XXIII, Boite Postal No. 57 06332 Grasse Cedex	Manager	- no reply
Pierrefitte-Auby	4 Av Velasquex, 75008 Paris 8E	Manager	- no reply
Rhone-Poulenc	22 Avenue de Montaigne, 75360 Paris, Cedex 08	Manager	- no reply - see Rhone Poulenc Inc, U.S.A. - see Lautier Aromatiques Ltd. UK
Rousell-Uclaf	35 bd des Invalides, 75007 Paris 7E	Manager	- no reply
Greece			
Vioryl	Terma Kifissia	Manager	- interested - wanted samples - broker - interested in other oils
Italy			
Anic S.P.A.	20097 San Donato, Milanese (MI)	Manager	- no reply
Misitano & Stracuzzi s.n.c.	5, via Nicola Fabrizi, 1.98100 Messina	Manager	- no reply
Montedison Group SPA	20121 Milano, Foro Buonaparte 31	Manager	- no reply
SIR Consorzio Industriale SPA	Via Grazioli 33-20161 Milano (MI)	Manager	- no reply

WESTERN EUROPEAN COMPANIES cont'

COMPANY	ADDRESS	CONTACT	COMMENTS
Italy con't			
Snia Casa SPA	00165 Roma, Via Aurelia 294	Manager	- no reply
Speda-Roccalumera SPA	Via Galvani 3, ZIR, Messina 98100	Manager	- no reply
Netherlands			
Akzo N.V.	6800 LS Arnhem, Postbus 186 Ijssellaan 82	Manager	- no reply
Sweden			
A.B. Astra-Dinol	Box 149, S-281 01 Hassleholm	Manager	- no reply
Switzerland			
Cilaq-Chemie AG	CH-8201 Schaffhausen, Hochstrasse 205/209	Manager	- no reply
F. Hoffman - La Roche & Co. AG	CH-4002 Basel, Postfach Grenzacherstrasse 124	Manager	- no reply - see Hoffman La Roche USA
Sandoz AG	CH 4002 Basel 13, Postfach Lichstrasse 35	E. Tschan	- no interest - no application
Siber Hegner & Co. AG	CH-8022 Zurich 1, Postfach Talstrasse 14	C. Beusch	- interested - broker
Societe des Produits Nestle SA	Vevey, CH-1800 Vevey VD	Manager	- no reply - see Synfleur, U.S.A.
West Germany			
Bayer AG	Bayerwerk, 5090 Leverkusen	Manager	- no reply - see Haarmann & Reimers U.S.A.

WESTERN EUROPEAN COMPANIES cont'd

COMPANY	ADDRESS	CONTACT	COMMENTS
West Germany cont'd			
Boehringer Mannheim GMBH	Sandhofer Strasse 116, Postfach 51, 6800 Mannheim 31	Manager.	- no interest - no application
CH Boehringer Sohn	Binger Strasse 173, Postfach 200, 6507 Ingelheim am Rhein	Manager	- no reply
Dragoco Gerberding & Co. GMBH	Dragocostrasse, 3450 Holzminden	H.W. Rossman, Head of Buying Dept.	- no interest - no application - price too high - $14 per lb. - interested in other oils - uses (toiletries) - see Dragoco Inc. U.S.A.
Henkel KGaA	Henkelstrasse 67, 4000 Dusseldorf	Manager	- no reply - see Henkel Corp. U.S.A.
Hoechst Aktiengesellschaft	Postfach 80 03 20, 6230 Frankfurt am Main 80	Miss M. Keilbach Purchasing agent	- no interest - too expensive - interested in other oils at 50¢/lb.
Paul Kaders GMBH	Schaueburgerstrasse 21, 2000 Hamburg 21,	Manager	- interested - broker - interested in other oils
E. Merck Chemisch-Pharmazeutishe Fabrik	Frankfurter Strasse 250, Postfach 4119 6100 Darmstadt	Mr. Messinger	- no interest - no application - see Merck & Co. Inc. U.S.A.
Schering AG	Mullerstrasse 170-178, Postfach 650311, 1000 Berlin 65	Manager	- no reply

U.S. COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
Abbott Laboratories Chem. & Agriculture Products Div.	1400 Sheridan Rd. NORTH CHICAGO, ILL. 60064	Manager	- no reply
Adolphs Beauty Products Co.	413 N. 63, PHILADELPHIA, PA. 19151	Manager	- no reply
Air Products & Chemicals Inc.	P.O. Box 538 T, ALLENTOWN, PA. 18105	V.J. Grande Marketing Manager	- no reply - M&B contacted on cedar wood oil
Akzona Inc.	P.O. Box 2930, ASHEVILLE, NC 28802	Manager	- no reply
Alberto-Culver Co.	2525 Armitage Ave. MELROSE PARK, ILL. 60160	Miss G.C. Claros Chemical Buyer	- no interest - no application - user (toiletries)
Alexander Astrack Co. Inc.	58-25 52nd Ave. WOODSIDE, NY. 11377	Raymond H. Wells President	- no reply - See Food Complex Co. Inc.
Allied Chemical Corp. Specialty Chemical Div.	P.O. Box 1087R, MORRISTOWN, N.J. 07960	Paul A. Mikitik Senior purchasing agent	- no interest - no application
Alpine Aromatics Int'l Inc.	P.O. Box 246 T - METUCHEN, N.J. 08840	Emil Buongiorno President	- no reply
American Aromatics Inc.	1295 North Blvd. MANHASSET, L.I. NY 11030	Rene Bourguet President	- no reply
American Cyanamid Co. Organic Chemical Div.	Berdan Avenue, WAYNE, N.J. 07470	Manager	- no reply
American Flavors Fragrance Corp.	110 Kennedy Drive, SMITHTOWN, N.Y. 11787	Grant M. Sweet President	- no reply
American Hoechst Corp. Industrial Chemical Div.	Route 202/206 N. SOMMERVILLE, N.J. 08876	Manager	- no reply
Amway Corp.	7575 E. Fulton Rd., ADA, MICH. 49355	Robert Hamilton	- interest, telephoned, no interest unless price $3-3.50 per lb. at this price might taken 15,000 to 20,000 kg per yr. Interested in other oils at $3-3.50 per lb.

U.S. COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
Aromatics International	549 Webb Industrial Drive NE., MARIETTA, GA. 30062	K.J. Keiser	- no reply
Avon Products Inc.	9 W. 5th Street, NEW YORK, NY. 10019	Mr. R.J. Dintemann	- no reply - see Avon Canada Ltd.
Badische Corp.	P.O. Drawer Dr. WILLIAMSBURG, VA. 23185	Manager	- no reply
Baromatic Corp.	P.O. Box 7, GREAT NECK, NY. 11022	J.W. Baer President	- no reply
BASF Wyandotte Corp. Industrial Chem Group/Polymers Group	Alkali Square, WYANDOTTE, MICH. 48192	Manager	- no reply - see Fritzsche Dodge & Olcott
Bedoukian Research Inc.	Finance Drive, Commerce Park, DANBURY, CT. 06810	Dr. P. Bedoukian President	- no interest - no application
Beechem Products	1100 W. State St., ST. JOHNS, MICH. 48879	Manager	- no reply
Robert C. Beegle Co. Inc.	P.O. Box 3194, SALEM, ORE. 97302	Shirley L. Beegle President	- no reply
Wm. M. Bell Co.	3312 Bloomingdale Ave. MELROSE PARK, ILL. 60160	James Heinz	- no reply
Belmay Company, Inc.	641 Avenue of the Americas, NEW YORK, NY. 10011	Morton Kesten President	- letter returned unopened
Berje Chemical Products Inc.	43-10A 23rd St., LONG ISLAND CITY, NY. 11101	J. Les Bleimann President	- interested - for resale and captive use (toiletries) - 1-2000 kg. per year (?) - M&B contacted: interest expressed - interested in other oils
Fred Berlage Co.	P. O. Box 4117, MOUNT KISCO, NY. 10549	Manager	- no reply - M&B contacted no interest - See Keith Harris/Plaimar
Bertrand Freres Ltd.	17 Brook Ave., MAYWOOD, NY. 07607	Douglas S. Dodge	- letters returned unopened

U.S. COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
Betz Laboratories	Somerton Rd., TREVOSE, PA. 19047	Manager	- no reply
Biddle Sawyer Corp. Aroma Resources Div.	2 Penn Plaza, NEW YORK, NY. 10001	B. Benveniste Vice President	- no reply - telephoned - no interest - too expensive
Big Three Industries Inc.	P. O. Box 3047 TR, HOUSTON, TX. 77001	Manager	- no reply
Block Drug Company Inc.	257 Cornelison Ave. JERSEY CITY, NJ. 07302	Richard C. Schaffer Director purchasing	- no interest - user (toiletries)
Bristol-Myers Company	345 Park Ave., NEW YORK, NY. 10022	Manager	- no reply
M. Brown & Son Inc.	P.O. Box 215, BREMEN, IN. 46506	Irvin N. Brown President	- no reply
Bush Boake Allen Inc.	7 Mercedes Drive, MONTVALE, NJ. 07645	P.T. Wood President	- interested - See Givaudan Corp. USA - see Bush Boake Allen, UK - see Bush Boake Allen, Canada - user (perfumes) - interested in other oils
John H. Calo Co. Inc.	P.O. Box 277, 99 West Hawthorne Ave. VALLEY STREAM, NY.	Kevin F. Canavan Sales Manager	- no reply
Camilli, Albert & Laloue	423 W. 55 St. NEW YORK, N.Y. 10019	Marguerite Wytenhove Sales Representative	- returned unopened
Carter-Wallace Inc.	767 5th Ave., NEW YORK, NY. 10022	Manager	- no interest
Celanese Corp. Celanese Coatings & Specialties Co.	1 Riverfront Plaza, LOUISVILLE, KY. 40202	Manager	- no reply - see British Celanese, UK.
Centflor Mfg. Co., Inc.	545 - TW 45th St., NEW YORK, NY. 10036	Arnold Beller President	- no interest - price too high - 2000 kg per yr if $10-12 per lb. - visited - interested in other oils

U.S. COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
L.A. Champon & Co. Inc.	70 Hudson St., HOBOKEN, NJ. 07030	Bernard P. Champon Sr. President	- possible interest - no application - too expensive
Charabot & Co. Inc.,	83 Cedar Lane, ENGLEWOOD, NJ. 07631	Raymond G. Strobl President	- no reply
Chemed Corp.	1200 DuBois Tower, CINCINNATI, OHIO 45202	Manager	- no reply
Chemessence Inc.,	351 Courtland Ave., STAMFORD, CT. 06906	Donald E. Lavelle President	- no reply
Chem-Fleur, Inc.	189-T Clifford St., NEWARK, NJ. 07105	Thomas J. Plocek President	- no reply
Chesebrough-Ponds Inc.	33 Benedict Place, GREENWICH, CONN. 06830	F.R. Deihl, Senior Purchasing agent	- no interest - no application - user (perfumes & toiletries)
China Products Northwest Inc.	2207 Seattle Tower, SEATTLE, WA. 98101	Ronald P. Phipps President	- returned unopened
Church & Dwight Co. Inc. Specialty Chemicals Div.	20-T Kingsbridge Rd. P.O. Box 369, PISCATAWA, NJ. 08854	Manager	- no reply
Ciba-Giegy Corp. Agricultural Division	P.O. Box 11422, GREENSBORO, NC. 27409	Dr. R.J. Patterson Manager Advanced Technology	- no questionnaire sent - visited - interested - too expensive
Citrus & Allied Essences Inc.	65 S. Tyson Avenue, FLORAL PARK, NY. 11001	Richard C. Pisano President	- no reply
Clorox Co.	1221 Broadway, OAKLAND, CAL. 94612	Manager	- no reply
Colgate-Palmolive Co.	302 Park Avenue, NEW YORK, NY. 10022	Manager	- no reply - M&B contacted: no interest
Comax Mfg. Corp.	80-00 Cooper Ave., GLENDALE, NY. 11227	Dr. Peter J. Calabretta President	- no reply

U.S. COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
Compo Industries Corp.	124 Roberts Rd. WALTHAM, MASS. 02154	Manager	- no reply
Continental Aromatics	1 Thomas Road South, HAWTHORNE, NJ. 07507	Barry Schaffer Vice President - Sales	- no reply
Coutin Associates Inc.	254 Nassau Street, PRINCETON, NJ. 08540	Pierre J. Coutin President	- no reply
Crompton & Knowles Corp. Flavor & Fragrances Division	345 Park Avenue, NEW YORK, NY. 10022	James H. Van Dyke Purchasing Manager	- no reply
Helene Curtis Industries Inc.	4401 W. North Avenue, CHICAGO, ILL. 60639	Manager	- no reply
Cutter Laboratories	4th & Parker Sts., BERKELEY, CA. 94710	S.C. Mutha Manager Formulations & Product Evalution Lab	- no interest - no application - user (insect repellants)
Gerard J. Danco Int'l Corp.	17 Elm, MORRISTOWN, NJ. 07960	Gerard J. Danco President	- no reply
de Laire, Inc.	950 Third Avenue, New York, NY. 10022	Kenneth L. Wessel President	- no reply
The Dexter Corp.	2 Elms St., WINDSOR LOCKS, CONN. 06096	Manager	- no reply
Diamond Shamrock Corp.	Diamond Shamrock Tower, 717 N. Hardwood, DALLAS, TX.	Manager	- no reply
Dow Chemical USA Health & Consumer Products Div.	P. O. Box 68511, INDIANAPOLIS, IND. 46268	Manager	- no reply
Dragoco Inc.	P.O. Box 261, Gordon Drive, TOTOWA, NJ. 07512	Miss P.H. Halle Senior Buyer	- no interest - no application - mfgr. of artifical aromas - see Dragoco, W. Germany
E.I. DuPont de Nemours & Co. Inc. Dupont Co. Chemicals, Dyes & Pigments Div.	1007 Market St., WILMINGTON, DEL. 19898	Manager	- no reply
Eastman Kodak Co.	343 State Street, ROCHESTER, NY. 14650	Manager	- no reply - M&B contacted on cedar wood oil

U.S. COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
Elan Chemical Co.	268 Doremus Ave., NEWARK, NJ. 07105	Sigmund Hoffman Sales Manager	- no reply
Elias Fragrances Inc.	999 East 46th Street, BROOKLYN, NY. 11203	Frank Canonica Manager of Laboratories	- interested - 50 kg. per year - user (perfumes) - telephoned - interested in other oils
Essex Chemical Corp. Specialty Chemical Division	1-T Crossman Rd. S., SAYREVILLE, NJ. 08872	Manager	- no reply
Ethyl Corp.	330 S. 4th., RICHMOND, VA. 23219	Manager	- no reply
Faberge Inc.	1345-T Ave. of Americas, NEW YORK, NJ. 10019	Manager	- no reply
Felton International Inc.	599 Johnson Ave., BROOKLYN, NY. 11237	Ira B. Kapp Chairman	- no reply - see Felton Int'l. - Canada
Firmenich Incorporated	P.O. Box 5880, PRINCETON, NJ. 08540	Robin Wardell	- no questionnaire sent - telephone contact - see Firmenich & Co. U.K.
Flavormatic Ind. Inc.	34-09 56th Street, WOODSIDE, NY. 11377	Judith Back President	- no reply
Florasynth, Inc.	410 East 62nd St., NEW YORK, NY. 10021	Mark Wolfson Vice-President Operations	- no reply - see Florasynth (Canada) Ltd.
Florida Food Ingredients Inc.	1699 67th Ave. South, ST. PETERSBURG, FL. 33712	Louis Mignacca President	- no reply
Food Complex Co. Inc.	58-25 52nd Ave. WOODSIDE, NY. 11377	R.G. Groncki Vice. Pres. Research & Devel.	- may be interested; depends on quality and price - broker plus user (toiletries) - see Alexander Astrack Co. Inc. - interested in other oils
Food Materials Corp.	2711 W. Irving Park Rd., CHICAGO, ILL. 60618	Charles A. Walsh Sales & Technical Marketing	- no interest - no application - user (artifical aromas)

U.S. COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
Fries & Fries	1000 Redna Terrace, CINCINNATI, OH 45215	Robert G. Fries, Jr.	- no reply
Fritzsche Dodge & Olcott Inc.	76 Ninth Ave., NEW YORK, NY 10011	Dr. J. Rogers	- no interest in cedar leaf oil - interest in other oils - visited - M & B contacted - see BASF Wyandotte Corp., U.S.A.
GAF Corporation	140 W. 51st, NEW YORK, NY. 10020	Manager	- no interest
Gentry International Inc.	17-01 Nevins Road, FAIR LAWN, NJ 07410	Manager	- no reply
Gillette Co.	30 Burtt Road, ANDOVER, MA 01810	Miss L. Fredrickson	- no interest - no application
Givaudan Corp.	100 Delawanna Ave., CLIFTON, NJ 07014	John T. Broderick	- questionnaire not sent - telephoned - no interest - no application - M & B contacted: no interest - see Roche Products Ltd., UK.
WR Grace & Co.	55 Hayden Ave., LEXINGTON, MASS. 02173	Manager	- no reply
R.W. Greeff & Co. Inc.	1445 E. Putnam Ave., OLD GREENWICH, CT 06870	Anthony E. D'Andrea	- no reply
Haarmann & Reimer Corp.	111 U.S. Highway 22, P.O. Box 175, SPRINGFIELD NJ 07081	Dr. G.S. Clarke	- interested - need samples to see if customer interested - broker plus user (perfumes) - 1000-3000 kg. per year - visited - see Bayer AG, W. Germany

U.S. COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
Hack Chemical Co.	Section B, Box 389, LOVELAND, CAL. 80537	Manager	- no reply
Hartog Trading Corp.	515 Madison Ave., NEW YORK, NY 10022	Antonio Casas	- no reply
Henkel Corp.	4620 W. 77 St., MINNEAPOLIS, MINN. 55435	Manager	- no reply - see Henkel, W. Germany
Hercules Inc.	910 - T Market Street, WILMINGTON, DEL. 19899	Manager	- no reply - see P.F.W.
Hoffman-LaRoche Inc.	Kingsland Rd. & Bloomfield Ave., NUTLEY, NJ. 07110	Manager	- no reply - see Hoffman-LaRoche & Co. AG, Switzerland
Hooker Chemical	1980 S. Post Oak Road, P.O. Box 4289, HOUSTON, TEXAS 77210	Manager	- no reply - M & B contacted on cedar wood oil
JM Huber Corp.	Thornall St., EDISON, NJ. 08837	Manager	- no interest - no applications - too expensive
Humsey Chemical Co. Inc.	6005 - 5th Ave., BROOKLYN, NY 11220	J.D. Humsey	- no reply
Philip A. Hunt Chemical Corp.	Organic Chemical Div. 1 Wellington Rd., LINCOLN, RI. 02865	Manager	- no reply
D.W. Hutchinson & Co.	700 South Columbus Ave., MT. VERNON, NY 10550	Arthur H. Brown	- no reply
Hymes Aromatics	77 Park Terr. E., NEW YORK, NY 10021	L.J. Hymes	- no reply
ICD Chemicals Inc.	641 Lexington Ave., NEW YORK, NY 10022	David Cookson	- no reply
ICI Americas Inc.	Concord Pike & New Murphy Rd., WILMINGTON, DEL. 19897	Manager	- no reply
Industrial Aromatic Co. Inc.	511 East 72nd St., NEW YORK, NY 10021	Nancy Mendes	- no reply
Int'l Flavors & Fragrances Inc.	521 West 57th St., NEW YORK, NY 10019	J. Corley	- no interest - price too high - $3-$6 per lb. required

U.S. COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
			- visited - M & B contacted: interested - interested in other oils - user (perfumes, aromas) - see IFF (Canada) Ltd.
Ivolin Enterprises, Inc.	500 Fifth Ave., Suite 4330 NEW YORK, NY. 10036	George Ivolin	- no reply
Johnson & Johnson	501 George, NEW BRUNSWICK, NJ. 08903	Manager	- no reply
JPM Imports Inc.	48-10 Astoria Blvd., ASTORIA, NY. 11103	Laure Moutet	- no interest - no application - broker
Kalsec Inc.	P.O. Box 511, KALAMAZOO, MI. 49005	Howard Cripps	- no reply
Mary Kay Cosmetics Inc.	8787-T Stemmons Frwy., DALLAS, TEX. 75247	Manager	- no reply
Keith Harris/Plaimar	P.O. Box 417, MOUNT KISCO, NY. 10549	Fred P. Berlage	- no reply - see Fred Berlage Co.
Kialing Co. Ltd.	23 Cheshire Drive, FARMINGVILLE, NY. 11738	Chen-Ming Wu	- no reply
Knomark Mfg. Co. Inc.	132 - 20 Merrick Blvd., JAMAICA, NY. 11434	Manager	- no reply
Kolmar Laboratories Inc.	PORT JERVIS, NY. 12771	Manager	- no reply
Labbeemint, Inc.	P.O. Box 130, HARRAH, WA. 98933	Jack V. Labbee	- no reply
Lautier Aromatiques Rhone-Poulenc, Inc.	5 Pearl Court, ALLENDALE, NJ. 07401	George M. Volpe	- no reply - see Lautier Aromatiques Ltd, UK.
LeaRonal Inc.	272 Buffalo Ave., FREEPORT, NY. 11520	Manager	- no reply
Wm. Leman , Inc.	P.O. Box 155, BREMEN, IN. 46506	S.E. Leman	- no reply

U.S. COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
Lever Bros. Corp.	390 Park Avenue, NEW YORK, NY. 10022	Manager	- no reply - M & B contacted: no interest - see Unilever Ltd., UK
Lilly, Eli & Co.	307 East McCarty St., INDIANAPOLIS, IND. 46206	Manager	- no reply
Lipo Chemicals Inc.	207 19th Ave., PATERSON, NJ. 07504	Louis B. Frischling	- no reply
Lo Curto & Funk Inc.	15 Maiden Lane, NEW YORK, NY. 10038	Laurence J. Quigley	- no reply
The Lubrizol Corp.	29400 Lakeland Blvd., Dept. 720, WICKLIFFE, OHIO 44092	Manager	- no reply
Lucta U.S.A. Inc.	25-35 Davis Court, LONG ISLAND CITY, NY. 11101	Leonard King	- no reply
Ludwig Mueller Co. Inc.	2 Park Ave., NEW YORK, NY. 10016	Alvin Slobard	- no reply
M & T Chemicals Apogee Operation	270 E. Grand Ave., SOUTH SAN FRANCISCO, CAL. 94080	Manager	- no reply
Mallinckrodt Inc.	675-T Brown Rd., ST. LOUIS, MO. 63134	Manager	- no interest - see Perry Bros., U.S.A.
V. Mane Fils Inc.	16 Spielman Rd., FAIRFIELD, NJ. 07006	Peter A. Thorburn	- no reply
J. Manheimer Inc.	47-22 Pearson Place, LONG ISLAND CITY, NY. 11101	Arnold Manheimer	- interested - broker - 5000 - 10,000 kg per year - visited - M & B contacted: interested - interested in other oils
Maschmeijer Aromatics Inc.	Route 6 - Stony Hill Road BETHEL, CT. 06801	D. Eddy Wijnberg	- returned unopened

U.S. COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
Medallion International Inc.	944 Belmont Avenue, NORTH HALEDON, NJ. 07508	Michael G. Boudjouk	- interested - mfgr. of fragrances - 1000 - 5000 kg new year - interested in other oils
Meer Corporation	9500 Railroad Avenue, NORTH BERGEN, NJ. 07047	M.A. Roses	- no interest - no application
Mentholatum Co. Inc. Baracaide Div.	1360 Niagara St., BUFFALO, NY. 14213	Manager	- no reply
Merck and Co. Inc. Merck Sharp & Dohme Div.	WEST POINT, PA. 19486	Manager	- no reply - M & B contacted on cedar wood oil - see E. Merck, W. Germany
Mero Aromatics Inc.	1140 Broadway, Rm. 1405, NEW YORK, NY. 10001	Henri Bour	- no reply
Miles Laboratories	P.O. Box 932, ELKHART, IND. 46515	Manager	- no reply
Mobay Chemical Corp. Industrial Chemicals Div.	Penn-Lincoln Pky. W., PITTSBURG, PA. 15205	Manager	- no reply
Monsanto Industrial Chemicals Co.	800 N. Lindbergh Blvd., ST. LOUIS, MO. 63166	Manager	- no reply - see Monsanto Ltd, UK
Morton Pharmaceuticals Inc.	1625 N. Highland, MEMPHIS, TENN. 38108	Manager	- no reply
Naarden International USA Inc.	919 Third Avenue, NEW YORK, NY. 10022	James J. Apostol	- no reply - telephoned - no interest - no applications - see Naarden Canada
Nalco Chemical Co. Specialty Chemicals Div.	2901 Butterfield Rd., Dept. 81-T, OAK BROOK, ILL. 60521	Manager	- no reply

U.S. COMPANIES

COMPANY	ADDRESS	CONTACT	COMMENTS
National Distillers & Chemical Corp.	99 Park Ave., NEW YORK, NY. 10016	Manager	- no reply
NCH Corp.	P.O. Box 2170-T, IRVING TEX. 75061	Manager	- no reply
Neumann-Buslee & Wolfe, Inc.	521 Santa Rose Drive, DES PLAINES, IL. 60018	Gene D. Kielhofer	- no reply
Norda Inc.	140 Route 10, EAST HANOVER, NJ. 07936	Robert B. Magnus, Jr.	- no reply - M & B contacted: no interest - see Norda Inter. Ltd. Canada
Noville Essential Oil Co. Inc.	1312 Fifth Street, NORTH BERGEN, NJ. 07047	William Widlund	- no reply
Noxell Corp.	P.O. Box 1799, BALTIMORE, MD. 21203	R.B. Butler	- no interest
Oaklite Products Inc.	50 Valley Rd., BERKELEY HEIGHTS, NJ 07922	Manager	- no reply
Ogawa & Co. Ltd.	2600 Netherland Ave. South, Suite 2101, BRONX, NY. 10463	Kazue Akiyama	- no reply
Penick Corp.	1050 Wall St. W., LYNDHURST, NJ. 07071	Richard R. Ferraro	- no reply - M & B contacted: no interest
Pennwalt Corp. Chemical Specialties Div./Organic Chemical Div.	Pennwalt Bldg. 3 Parkway, PHILADELPHIA, PA. 19102	Manager	- no reply
Perfumery Associates Inc.	599 Broadway, NEW YORK, NY. 10012	Henry Retailliau	- returned unopened
Perry Bros. Fragrances	Div. Mallinckrodt Inc. 61-10 32nd Ave., WOODSIDE, NY. 11377	Stanley F. Rutkowski	- interested - price too high - require $8 - 10 per lb. - see Mallinckrodt Inc. - user (aromas) - interested in other oils

U.S. COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
Petrolite Corp., Bareco Div.	6910 E. 14th St., P.O. Drawer K TULSA, OKLA. 74112	Manager	- no reply
PFW Div. of Hercules Inc.	33 Sprague Ave., MIDDLETOWN, NY 10940	Maurice Raviol	- no interest - too expensive - if $2 - $5 per lb. 2000 kg per year - telephoned - see Hercules Inc. - interested in other oils - see PFW Frutal Sales, Canada
Polak's Frutal Works Inc.	33 Sprague Avenue, Middletown, MIDDLETOWN, NY 10940	Manager	- no reply - see PFW, Div. of Hercules Inc.
Polarome Manufacturing Co. Inc.	22T Ericsson Place, NEW YORK, NY 10013	Bruce Barosh	- may be interested - too expensive - broker/dealer - 5000 kg per year at $10 - $12/lb. - visited - interested in other oils
PPG Industries	Coatings & Resins Div. 1 Gateway Centre, PITTSBURGH, PA. 15222	J.V. Boughner	- no interest - no application
Procter & Gamble Co.	P.O. Box 599, CINCINNATI, OHIO 45201	B. Corbett, Buyer	- no reply - telephoned - no interest - too high a price - need $1 - $2 per lb.

U.S. COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
Proprietary Perfumes Ltd.	17 Brook Ave., MAYWOOD, NJ 07607	M.E. Patterson	- returned unopened
Purex Corp.	24600 S. Main St., CARSON, CAL. 90749	Manager	- no reply
Redken Laboratories	6625-T Variel Ave., CANOGA PARK, CAL. 91303	Manager	- no reply
Reichold Chemical Inc.	523 N. Broadway, WHITE PLAINS, N.Y. 10603	Manager	- no reply
Reynaud Inc.	400-A Trumbull Street, ELIZABETH, NJ 07206	Manager	- no reply
Revlon Inc.	767 5th Ave., NEW YORK, NY. 10022	Manager	- no reply
Rhone Poulenc Inc.	Blackhorse Lane P.O. Box 125, MONMOUTH JUNCTION, NJ 08852	Manager	- no reply - see Rhone-Poulenc, France
Richardson-Vicks Inc.	P.O. Box V, HATBORO, PA 19040	A.J. Risi	- no reply - visited - no interest - too expensive
Ritter International	4001 Goodwin Ave. P.O. Box 39696, LOS ANGELES, CA. 90039	A.E. Katz	- no reply
P. Robertet Inc.	125 Bauer Drive, OAKLAND, NJ 07436	John K. Funesti	- no reply
A.H. Robins Co.	1407 Cummings Dr., RICHMOND, VA. 23220	Manager	- no reply
Rohm and Haas Co.	P.O. Box 18183, PHILADELPHIA, PA. 19116	Manager	- no reply
William H. Rorer Inc.	500 Virginia Dr., FORT WASHINGTON, PA. 19034	G.P. Fox	- no interest - no application - user

U.S. COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
Roure Bertrand Dupont Inc.	1775 Windsor Rd., TEANECK NJ 07666	C. Delorenzo	- no interest - user (perfumes, toiletries)
SCM Corporation	Glidden Organic Chemicals Group P.O. Box 389, JACKSONVILLE, FLORIDA 32201	B.J. Kane	- no reply - telephoned - interested in thujone - interested in other oils at $1 per lb.
E.L. Scott & Co. Inc.	One World Trade Center Suite 2347, NEW YORK, NY 10048	Edward L. Scott, Jr.	- no reply
G.D. Searle and Co.	B303 Elmbrook Dr., DALLAS, TEX. 75247	Manager	- no reply
Sharp Chemical Co.	5921 Plainview, HOUSTON, TEXAS 77087	Manager	- no reply
Shaw Mudge & Co.	16 Dyke Land, STAMFORD, CT 06902	Shaw Mudge	- interested - no application - price too high - 100 kg per year to start - user (toiletries) plus broker - interested in other oils
Shell Chemical Co.	1 Shell Plaza, HOUSTON, TEX. 77001	J.H. Laws	- no interest - too expensive - 10,000 tonnes per year if $0.25 - $0.50 per lb.
Sherex Chemical Co. Inc.	5200-T Blazer Memorial Pky. P.O. Box 646, DUBLIN, OHIO 43017	W.E. Link	- no interest - no applications - too expensive
M. Sluis Co. Inc.	15 Park Row, NEW YORK, NY 10038	Henri Elion	- no reply

U.S. COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
Smithline Corp.	P.O. Box 7929, PHILADELPHIA, PA. 19101	Manager	- no reply
E.C. Snyder Corp.	P.O. Box No. 1243, WESTON, CT 06883	Edward C. Snyder	- no reply
Harold A. Sothern & Co. Inc.	Tower Hill Road, SCARBOROUGH, NY 10510	Roger T. Kiley	- no reply
Squibb-Beech Nut Inc.	40 W 47th Street, NEW YORK, NY 10019	Manager	- no reply - M & B contacted on cedar wood oil
Standard Aromatics Inc.	88 University Place, NEW YORK, NY 10003	Marvin Balsam	- no reply
Stauffer Chemical Specialty Chemical Div.	Nyala Farm Rd., WESTPORT, CONN.06880	Manager	- no reply
Stepan Chemical Corp. Maywood Div.	100 W. Hunter Ave., MAYWOOD, NJ 07607	Manager	- no reply
Sterling Drug Inc.	90 Park Ave., NEW YORK, NY. 10016	Manager	- no reply
Sunkist Growers Inc.	700 E. Sunkist St., ONTARIO, CA 91761	Dr. D.B. Nelson	- no interest - no application
Synarome Corp. of America	55 Vandam St., NEW YORK, NY 10013	Robert L. Mendoza	- no reply
Synfleur Subs. of Nestle Co. Inc.	33 Lakewood Ave., MONTICELLO, NY 12701	Dr. P. Bessinger	- interested - 1000 kg per year max. - user (toiletries) and broker - visited - see Societe des Produits Nestle SA, Switzerland - interested in other oils
Taconic Natural Oil Co.	NEW YORK, NY.	Manager	- no reply - M & B contacted: no interest

U.S. COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
Takasago USA Inc.	41-12 38th St., LONG ISLAND CITY,NY 11101	Motoichi Indo, Ph.D.	- returned unopened
Thiokol Corp.	Newtown - Yardley Rd., NEWTON, PA. 18940	Manager	- no reply
A.M. Todd Co.	1717 Douglas Ave., P.O. Box 711 KALAMAZOO, MI 49005	I. Blair	- no interest - no application - too expensive - broker
Tombarel Products Corp.	400 Bergen Blvd., PALISADES PARK,NJ 07650	R.W. Gilvey	- returned unopened
George Uhe Co. Inc.	76 Ninth Ave., NEW YORK, NY 10011	C. Lloyd Fischbeck	- no reply
Ungerer & Co.	4 Bridgewater Lane, P.O. Box U LINCOLN PARK, NJ 07035	K.G. Voorhees, Jr.	- no reply - M & B contacted: interested
Union Camp Corp. Chemical Div.	P.O. Box 60369, JACKSONVILLE, FL 32205	J.B. deBauernfeind	- no reply
Universal Fragrances Corp. of Universal Flavor Corp.	124 Case Dr., SOUTH PLAINFIELD,NJ 07080	L.J. Noling	- no reply
Union Carbide Corp. Home & Automotive Products Div.	270 Park Ave., NEW YORK, N.Y. 10017	Manager	- no reply
UDP Chemical Division	State Highway 17, EAST RUTHERFORD,NJ 07073	Henry M. Mellett	- no longer in business
Upjohn Co. Fine Chemicals Division	7000 Portage Road, KALAMAZOO, MI 49001	Manager	- no reply - M & B contacted on cedar wood oil
Van Dyk & Co. Inc.	Main & William Sts., BELLEVILLE, NJ07109	Howard Isermann	- no reply

U.S. COMPANIES CONT'D

COMPANY	ADDRESS	CONTACT	COMMENTS
Ventura Coastal Corp.	2325 Vista Del Mar Drive P.O. Box 69, VENTURA, CA 93001	Manager	- no reply
Albert Verley & Co.	124 Case Dr., SOUTH PLAINFIELD, NJ 07080	Pierre C. Parchois	- no reply
John D. Walsh Co. Inc.	66 Glen Ave., GLEN ROCK, NJ 07452	L. Serafine	- interested - wants samples - broker - telephoned
Warner-Jenkinson of 7Up Co.	2526 Baldwin St., ST. LOUIS, MO 63106	Stephen G. Capkovitz	- no reply
Warner Lambert	201 Tabor Road, MORRIS PLAIN, NJ 07950	Warner Lambert	- no reply
Witco Chemical Corp.	2 Wood St., PATERSON, NJ 07524	Manager	- no reply

APPENDIX E

PRICE LISTS OF ESSENTIAL OILS

E. L. SCOTT & COMPANY, INC.

Successors to JULIAN W. LYON • Established 1916

AGENTS & BROKERS
ESSENTIAL OILS • SPICES & BOTANICALS
AROMA CHEMICALS • JUICE CONCENTRATES

ONE WORLD TRADE CENTER • SUITE 2347 • NEW YORK, N. Y. 10048 • CABLE: "ELSCOTCO" NEW YORK • TELEPHONE: (212) 432-0100 • TELEX 12-6681

CURRENT OFFERS

MAY 6, 1981

ESSENTIAL OILS

ANGELICA ROOT	900.00 K
ANISE SEED - STAR	28.00 K
ARTEMISIA	45.00 K
BALSAM PERU	8.50 FOB
BASIL - COMORES	82.50 K
BERGAMOT - FCC	XX
BIRCH - SWEET NORTHERN	9.75/18.75
BIRCH - SWEET SOUTHERN	4.00
CADE CRUDE	3.25 K
CADE RECTIFIED	6.45 K
+ CANANGA	30.00 K
CARROT SEED - FRENCH	120.00 K FOB
CASSIA - CHINESE 85/90%	PLS. ASK QUOTE
CEDARWOOD - LIGHT VIRGINIANA	2.90
CELERY SEED	27.20/36.75
CHAMOMILE BLUE	775.00 K
CHAMOMILE ROMAN	450.00/735.00 K FOB
CITRONELLA - CHINESE 85/35%	6.70 K
CITRONELLA - JAVA 85/35%	6.40 K
+ CLOVE LEAF - INDO. 80%	3.25 K
CLOVE LEAF - MADAGASCAR	PLS. ASK QUOTE
CORIANDER - YUGOSLAVIAN	PLS. ASK QUOTE
CUMIN	26.00
DILLSEED	PLS. ASK QUOTE
DILLWEED	PLS. ASK QUOTE
EUCALYPTUS 70/75% - PORTUGUESE	2.29
EUCALYPTUS 80/85%	2.68
FENNEL BITTER	18.50 K FOB
FENNEL FCC	18.50 K
GARLIC	120.00 K FOB
GERANIUM - BOURBON	81.50 K FOB
GERANIUM - CHINESE	30.50 K
GERANIUM - EGYPTIAN	36.00 K
GINGER - CHINESE	43.00 K
GINGER - FCC	60.00 K
GRAPEFRUIT - CALIFORNIA	0.90/1.00 FOB
GRAPEFRUIT - FLORIDA	1.10 FOB
- JUNIPER BERRIES - ITALIAN	42.00 K
LAVANDIN 30/32%	14.80 K
LAVENDER 40/42%	30.50 K FOB
LAVENDER SPIKE - SPANISH	11.75/15.45
LIME DISTILLED - MEXICAN	16.50 FOB
LIME EXPRESSED - MEXICAN	18.50 FOB
LITSEA CUBEBA - CHINESE	7.20
LEMON - ARGENTINA	PLS. ASK QUOTE
LEMON - FLORIDA	PLS. ASK QUOTE
LEMON - ITALIAN	PLS. ASK QUOTE
LEMONGRASS INDIAN 75%	9.60 K
MANDARIN - ITALIAN C.P.	43.00 K
MARJORAM - SPANISH	23.90 K
NEROLI BIGARADE	325.00/405.00
NUTMEG	15.50 K
OCOTEA CYMBARUM	PLS. ASK QUOTE
ONION	575.00 K
ORANGE - BRAZIL	PLS. ASK QUOTE
ORANGE - MIDSEASON -CALIF.	PLS. ASK QUOTE
ORANGE - MIDSEASON -FLA.	0.55 FOB
ORANGE - VALENCIA - CALIF.	0.65/0.80 FOBS
ORANGE - VALENCIA - FLA.	0.90 FOB
ORANGE - VALENCIA - MEX.	PLS. ASK QUOTE
ORANGE - W. I.	0.75
+ ORANGE ESSENCE	0.60 FOB
ORIGANUM 65%	15.50
+ PATCHOULI	33.00 K
PALMAROSA - INDIAN	25.00/28.00 K
PENNYROYAL	5.00
PEPPERMINT - YAKIMA/WILLAMETTE	PLS. ASK QUOTE
PIMENTO LEAF	12.00.
PINE NEEDLE - SIBERIAN	8.05
ROSEMARY - SPANISH	6.40
ROSEMARY - MOROCCAN	6.00
SAGE - SPANISH	13.55 FOB
SAGE CLARY - RUSSIAN	85.00 K FOB
SANDALWOOD TIMOR	80.00 K
SANDALWOOD - E. INDIAN	85.00 K
SASSAFRASS NATURAL	4.74
SAVORY - HUNGARIAN	40.00 K
SPEARMINT - NATIVE	PLS. ASK QUOTE
SPEARMINT - SCOTCH	PLS. ASK QUOTE
THYME - RED	XX
THYME - WHITE	33.00 K
TEMPLE	1.50 FOB
TANGELO	1.00 FOB
TANGERINE - FLA.	PLS. ASK QUOTE
TANGERINE - MEX.	24.00 K FOB
VETIVERT - BOURBON	FF 475.00 K FOB
+ VETIVERT - JAVA	24.00 K
WINTERGREEN LEAF - SOUTHERN	4.50
YLANG YLANG EXTRA COMORES	38.80 FOB
YLANG YLANG NO. 1 COMORES	27.10 FOB
YLANG YLANG NO. 2 COMORES	17.95 FOB
YLANG YLANG NO. 3 COMORES	13.15 FOB

FIXATIVES

MUSK GRAINS	48,000.00 K
BEAVER CASTOREUM	38.00
CIVET	XX

TERPENES & BY- PRODUCTS

D'LIMONENE	PLS. ASK QUOTE
LEMON	PLS. ASK QUOTE
LIME	PLS. ASK QUOTE

FOLLOWING TERPENES ALSO AVAILABLE:
GRAPEFRUIT, ORANGE, TANGERINE,
PEPPERMINT, SPEARMINT, EUCALYPTUS,
CITRONELLA, WASHED EXPRESSED OILS

GUMS, RESINOIDS & SPECIALITIES

LABDANUM GUM CRUDE	1.04
LABDANUM GUM PURIFIED	1.65
CISTUS RESINOID ABSOLUTE	9.20
CISTUS RESINOID CONCRETE	7.60
LABDANUM AMBRIENE	5.90
LABDANUM RESINOID CONCRETE	11.32 FOB
OAKMOSS RESINOID CONCRETE	11.20 FOB
OAKMOSS RESINOID ABSOLUTE	16.70 FOB
OAKMOSS RESINOID	XX
ROSEMARY RESINOID CONCRETE	6.00
ROSEMARY RESINOID ABSOLUTE	9.05
SPIKE LAVENDER RESINOID	9.45

AROMA CHEMICALS & INTERMEDIATES

ALPHA PINENE 95/100	1.18 FOB
ALLO OCIMENE	PLS. ASK QUOT
ALPHA TERPINEOL	1.50
ANETHOL 20/21	5.50 FOB
ANISE ALDEHYDE	XX
BENZYL ACETATE	1.04 FOB
BENZYL ALCOHOL	1.06 FOB
BETA PINENE	1.32
BORNEOL CRYSTALS, PURE	2.65
BORNYL ACETATE CRYSTALS	1.93 FOB
BORNYL ACETATE 96/98 LIQUID	1.18
COUMARIN	XX
DIPENTENE	0.53
DIPHENYL OXIDE	0.62 FOB
ETHYL VANILLIN	9.40 FOB
EUCALYPTOL - PORTUGUESE	3.40
FENCHYL ALCOHOL	3.84 FOB
GAYOL ACETATE	1.02
GERANYL ACETATE	5.90
HELIOTROPINE	7.55 FOB
ISO BORNEOL CRYSTALS	0.66 FOB
ISO BORNYL ACETATE	0.84 FOB
ISO THYMOL	1.13 FOB
LAEVO CARVONE	XX
LAEVO LIMONENE 65-PORT.	3.00 K
LAEVO LIMONENE, COMMERCIAL	0.35
MENTHOL BRAZIL	6.40 FOB
MENTHOL CHINESE	11.00 K
MENTHOL CRYSTALS, SMALL	6.50
MENTHONE 94%	5.90 FOB
NEROLIN BROMELIA	3.40
NEROLIN YARA YARA	3.25
PHENYL ACETIC ACID	2.59
PHENYL ETHYL ALCOHOL, PERFUMERY	2.95 FOB
PHENYL ETHYL ALCOHOL, STANDARD	2.85 FOB
TERPINEOL PERFUMERY	1.33
TERPINEOL, B.P.	1.25
TERPINYL ACETATE	1.54
VANILLIN	6.12 FOB
VETIVEROL	ON REQUEST
VETIVERYL ACETATE	34.00 FOB

OLEORESINS

PAPRIKA, GINGER & OTHER OLEORESINS

PLEASE ASK QUOTATION/PLEASE ASK FOR QUOTATIONS ON OTHER PRODUCTS FROM OUR EXTENSIVE LIST OF AROMATI CHEMICALS.

ALL PRICES COST & FREIGHT NEW YORK UNLESS OTHERWISE NOTED.

XX PRESENTLY UNAVAILABLE FROM SOURCE — ALL PRICES PER POUND UNLESS OTHERWISE NOTED — ALL OFFERS SUBJECT TO PRIOR SALE AND CABLE CONFIRMATION

The John D. Walsh Company, Inc.

65 GLEN AVENUE GLEN ROCK NEW JERSEY 07452
P.O BOX 507

AGENTS BROKERS
ESSENTIAL OILS
AROMATIC MATERIALS

(201) 444-3133
CABLE ADDRESS WALSHJON
TELEX 130346
4453094

MARKET REPORT

PRODUCT	SPOT	SHIPMENT
Amyris	9.25	*
Anise	13.50	26.90 K C&F
Armoise	27.50	172.00FF C&F
Balsam Peru	8.75	8.00 FOB
Balsam Copaiba	2.55	*
Bay 50/55%	10.50	9.50/10.25 FOB
Basil	46.00	355.00 K C&F
-Bergamot, Italian	35.00	68.00 K C&F
Birch, Northern	*	10.25 DELD.
Birch, Southern	*	4.25 DELD.
Black Pepper	*	28.00 K C&F
Bois de Rose, Brazilian	7.50	6.75 FOB
Boronia	*	2600.00 K C&F
Cabreuva	9.00	19.50 K FOB
Cade	2.25	1.35 C&F
-Cajaput	6.50	8.30 K C&F
Camphor, White .86/.88	1.75	2.80 K C&F
Camphor, 1.000	2.20	4.20 K C&F
Cananga	14.50	28.00 K C&F
Caraway	30.00	117.00DM FOD
Cardamom, Guatemalan	100.00	100.00 C&F
Carvone, Laevo	8.00	*
Cassia, Chinese	54.00	51.50 C&F
Cedarleaf	19.00	19.00 DELD.
Cedarwood, Virginiana	2.60	*
Cedarwood, Texas	1.90	1.75 FOB
Celeryseed	32.50	52.00 K C&F
Cinnamon Bark	75.00	92.62 C&F
Cinnamon Leaf, Ceylon	2.90	2.39 C&F
Citronella, Ceylon Estate	4.20	3.82 C&F
Citronella, Java 85/35%	3.20	6.20 K C&F
Civet	*	410.00 K C&F
Clovebud, Madagascar	18./25.00	40.00 K C&F
Cloveleaf, Indonesia	1.60	3.10 K C&F
Cloveleaf, Madagascar	1.90	*
Clovestem	6.00	*
Cognac	*	745.00DM KFOB
Coriander	27.00	215.00FF KC&F
Cubeb	33.00	31.00 K C&F
Dillweed	9.50	8.75 FOB
D'Limonene	.45	.41 FOB
Eucalyptus Citriodora	2.25	*
Eucalyptus 80% Chinese	2.10	4.30 K C&F
Eucalyptus Dives	*	2.20/2.30 K C&F
Eucalyptus 70/75% Spanish	2.60	2.45 C&F
Eucalyputs 70/75% Portufal	2.50	*
Eucalyptol N.F.	3.40/4.00	6.70 K C&F
Fennel, Bitter	*	6.65 C&F
Fennel, Sweet	10.00	7.05 C&F
Fir Needle, Canadian	9.50	8.00 DELD.
Fir Needle, Siberian	8.75	*
Galbanum	165.00	*
Garlic	70.00	135.00 K C&F
Geranium, Bourbon	45.00	240./398.00FF KFOB
Geranium, Egyptian	19.00	36./40.00 K FOB
Geranium, Morocco	28.00	280.00FF KFOB
Ginger	35./60.00	43./65.00 K C&F
Grapefruit, Pink	*	1.25 FOB
-Grapefruit, White	1.60	1.50 FOB
Guaiacwood	2.10	3.80/3.90 K FOB
Hemlock	*	4.75 DELD.
Ho Leaf 90%	6.50	13.00 K C&F
Ho Wood 90%	5.25	9.80 K C&F
Labdanum Gum	*	1.95/3.40 C&F
Lavandin Abrialis 30/32%	8.00	72.00 FF KC&F
Lavandin Grosso	5.00	40.00 FF KC&F
-Lavander Spike	12.00	11.80 C&F
Lavander 40/42%	20.00	127.50 FF KC&F
Lemon, Argentina	14.00	38.00 K FOB
Lemon, Brazil	14.00	*
Lemon, California	14.00	*
Lemon Terpenes	1.90/3.85	*
-Lemon, Italian	23.00	19.50 C&F
Lemongrass, Guatemalan	3.75	*
Lemongrass 75% Indian	4.75	9.15 K C&F
Lime, Distilled, Mexican	17.50	16.50 FOB
Lime, Distilled, Haitian	11.50	*
Lime, Distilled, Trinidad	*	*
Lime, Florida	17.50	*
Lime, Terpenes	4.50	3.94/4.95 FOB
Litsea Cubeba	3.25	*
Mandarin, Italian	20.00	18.00 C&F
Marjoram	*	7.65 C&F
Menthol, Natural	5.60/6.25	6.00/6.20 FOB
Menthol, Synthetic	5.25	*
Musk Ambrette	7.35	*
Nutmeg, E.I.	8.50	15.50 K C&F
Onion	240./315.00	560.00 K FOB
Ocotea Cymbarum	2.65	5.00 K FOB
Orange, Bitter, W.I.	*	*
Orange, Brazil	.55	*
Orange, Florida M/S	.60	.55 FOB
+Orange, Fl. Valencia	.80	.85 FOB
Orange Terpenes	.44	*
Origanum 70%	18.00	14.55 C&F
Palmarosa, Ind. 92/94%	15.00	*
+Patchouli	14.00	29.00 K C&F
Pennyroyal 80/85%	6.50	5.25 C&F
Peppermint, Yakima	10.75	9.00 FOB
Peppermint, Willamette	11.75	9.75 FOB
Peppermint, S.A. 45/50%	5.75	11./11.50 K FOB
Peppermint, S.A. 67/70%	6.00	12.00 K FOB
+Peppermint Terpenes	*	1.60/2.00 FOB
Petitgrain, S.A.	10.00	19.00 K FOB
Phellandrene	.90	1.40 K C&F
Pimento Leaf	11.75	11.00 C&F
Rosemary, Morocco	5.75	53.00 FF KFOB
Rosemary, Spanish	7.50	6.25 C&F
Rosemary, Tunisia	7.00	65.00/66.00 FF KFOB
Sage, Clary	60.00	415.00 K FOB
Sage, Dalmatian	25.50/34.00	104.00DM KFOB
Sage, Crude, Spanish	16.50	19.00 C&F
+Sandalwood, E I.	41.00	85.00 KC&F NY
Spearmint	10.00	9.00/9.50 FOB
Spearmint Terpenes	*	2.00 FOB
Tangerine, Florida	7.50	7.50 FOB
Thyme, Red 40/45%	*	11.45 C&F
Thyme, Red 50/55%	19.00	16.40 C&F
Thyme, White 65%	21.00	9.55 C&F
Wintergreen	*	4.75 DELD.
+Vanillin	4.25 DELD.	*
Vetiver, Bourbon	57.00	495.00 FF KFOB
Vetiver, Haitian	18.50	15.40/17.00 C&F
Vetiver, Java	11.00	21.00 K C&F
Ylang, Extra	*	355./390.00 FF KC&F
Ylang #1	*	225./285.00 FF KC&F
Ylang #2	*	180.00 FF KC&F
Ylang #3	*	145.00 FF KC&F

OLEORESIN	
Allspice	25.00
Basil	28.00
Bay Laurel	26.00
Black Pepper	10.60
Capsicum, Africa 500,000	9.00
Capsicum, Domestic 200,000	11.00
Celeryseed, French	8.50
Celery, Indian	6.50
Cinnamon	45.00
Clove	42.00
Coriander	14.50
Ginger	25.00
Mace, E.I.	8.70
Marjoram	34.00
Nutmeg	9.20
Oregano	35.00
Paprika 1,000 ASTA (40,000 CV)	10.60
Paprika 2,000 ASTA (80,000 CV)	21.20
Rosemary	11.50
Sage, Dalmatian	21.50
Turmeric Soluble	4.25
Thyme	14.00

+ = INCREASE — = DECREASE * = NO INDICATION

ALL PRICES UNITED STATES DOLLARS PER POUND UNLESS OTHERWISE INDICATED

MARCH 23, 1981

APPENDIX F

RICHARDSON-VICKS' PURCHASE SPECIFICATIONS

FOR CEDAR LEAF OIL

Vick Manufacturing Division, Richardson-Merrell Inc.

FORMULA INGREDIENT SPECIFICATIONS & TEST PROCEDURES

REFERENCE: VICK STANDARD and FCC		ITEM: CEDAR LEAF OIL	
DATE OF ISSUE: 5/12/75	REVISION NO.: 2	SAMPLE SIZE: 60 ml.	
APPROVALS: VMD R&D	RMI CODE NO. 200544 VMD CODE NO. 00136	PAGE: 1 of 4	

SPECIFICATIONS:

1.	Description	A colorless to yellow liquid having a characteristic odor of arbor vitae.*
2.	Solubility	Clearly soluble in 3 volumes of 70% ethanol.
3.	Specific Gravity, $25^{o}/25^{o}C$.	0.895 to 0.920
4.	Optical Rotation, $25^{o}C$.	-9^{o} to -14^{o} in a 1 dm. tube.
5.	Refractive Index, $20^{o}C$.	1.455 to 1.461
6.	Assay	Not less than 60.0% w/w ketones, calculated as Thujone.
7.	Odor	Must match standard sample as determined by an odor panel.
8.	GLC Profile	Is similar to typical curve (attached).

* Only oil from the eastern arbor vitae Thuja occidentalis is acceptable.

Vick Manufacturing Division, Richardson-Merrell Inc.

FORMULA INGREDIENT SPECIFICATIONS & TEST PROCEDURES

REFERENCE: VICK STANDARD and FCC		ITEM: CEDAR LEAF OIL	
DATE OF ISSUE: 5/12/75	REVISION NO.: 2		SAMPLE SIZE: 60 ml.
APPROVALS: VMD R&D	RMI CODE NO. 200544 VMD CODE NO. 00136		PAGE: 2 of 4

TESTING PROCEDURES:

2. Solubility

Transfer 30 ml. of water to a 100-ml. graduated cylinder. Add sufficient 100% ethanol to make 100 ml. Additional ethanol should be used to compensate for any shrinkage in volume; or use 26.3 ml. of water and diluted to 100 ml. with 95% Ethanol.

Transfer 10 ml. of sample into a dry 50-ml. graduated cylinder. Add 30 ml. of the 70% ethanol (prepared above) and mix the phases. The resulting solution should clear.

6. Assay

Not less than 60.0% w/w Ketones, calculated as Thujone.

Hydroxylamine HCl Solution:

Dissolve 20 g. of hydroxylamine hydrochloride (reagent grade or preferably freshly recrystalized) in 40 ml. of water and dilute to 400 ml. with 95% ethanol. Add, with stirring, 300 ml. of N/2 alcoholic KOH, and filter. Use this solution within two days.

Procedure:

Accurately weigh (by difference) 1 g. of Cedar Leaf Oil directly into a 250-ml. glass-stoppered Erlenmeyer flask. Use a second flask for a residual blank titration. Transfer 75.0 ml. of Hydroxylamine HCl solution (as prepared above) into the sample and blank flasks. Swirl to mix, attach a water-cooled condenser, and reflux gently for a minimum of 1 hour. Cool the flasks to room temperature. Titrate both flasks with accurately standardized N/2 HCl to a pH of 3.4 using a pH meter that was standardized with a suitable reference solution within ± 0.5 unit of pH 3.4.

Calculation:

$$\frac{(B - S)\ (N)\ (15.8)}{(\text{Sample wt.} - G.)} = \%\ \text{w/w Thujone}$$

Vick Manufacturing Division, Richardson-Merrell Inc.

FORMULA INGREDIENT SPECIFICATIONS & TEST PROCEDURES

REFERENCE: VICK STANDARD and FCC		ITEM: CEDAR LEAF OIL	
DATE OF ISSUE: 5/12/75	REVISION NO.: 2		SAMPLE SIZE: 60 ml.
APPROVALS: VMD R&D	RMI CODE NO. 200544 VMD CODE NO. 00136		PAGE: 3 of 4

TESTING PROCEDURES: (Continued)

Where: S = ml. of N/2 HCl for sample
B = ml. of N/2 HCl for blank
N = exact normality of N/2 HCl

8. GLC Profile

Chromatogram is similar to typical chromatogram (see next page).

Typical Gas Chromatograph Conditions are:

Experimental conditions employed at Mt. Vernon using a F & M 700 - 12 gas chromatograph are as follows:

Chromatograph:	Single column type with hydrogen flame detector.
Column:	CARBOWAX 20M, 30% w/w on CHROMOSORB W, 80/100 mesh, 6 ft. x 1/8-inch O.D.
Temperatures:	
Detector -	250°C. (approx.)
Injector -	250°C. (approx.)
Column -	135°C.
Gas Flow Rates:	Helium at 35 p.s.i.g. (inlet pressure) Hydrogen at 18 p.s.i.g. Air at 12 p.s.i.g.
Electrometer Range:	See attached curve
Injection:	0.2 λ
Recorder:	1 mv., 1 second 2 min./inch

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REFERENCE: VICK STANDARD and FCC	ITEM: CEDAR LEAF OIL	
DATE OF ISSUE: 5/12/75	REVISION NO.: 2	SAMPLE SIZE: 60 ml.
APPROVALS: VMD [signature] R&D [signature]	RMI CODE NO. 20[illegible]4 VMD CODE NO. 00166	PAGE: 4 of 4

CEDAR LEAF OIL - VMD ORGANOLEPTIC STANDARD

TIME	AREA	HT	FF	C	NAME
.38	.0020	.032	1.000	.0165	
.66	.0021	.006	1.000	.0111	
.82	.0049	.038	1.000	.0258	
.95	.0113	.075	1.000	.0597	
1.22	.0171	.422	1.000	.1000	
1.46	2.0212	.146	1.000	10.6550	
1.76	.4601	.176	1.000	2.4157	
2.18	.6674	.206	1.000	3.5048	
2.61	.0577	.261	1.000	.3033	
2.83	.2351	.253	1.000	1.2345	
3.34	.1062	.334	1.000	.5576	
3.73	.0777	.373	1.000	.4078	
3.84	.0131	.504	1.000	.0687	
5.33	.0261	.551	1.000	.1370	
6.44	2.3541	.694	1.000	11.3694	THUJONE COMPONENTS 72.9%
7.69	11.0144	.760	1.000	57.8447	
8.13	.5175	.813	1.000	2.7178	
8.70	.0120	.870	1.000	.0630	
10.16	.0163	1.016	1.000	.0856	
11.93	.4550	1.193	1.000	2.3894	
12.76	.0141	1.276	1.000	.0740	
14.04	.7377	1.404	1.000	3.8746	
15.54	.0111	1.554	1.000	.0583	

$10^2 \times 10$

$10^2 \times 50$

$10^2 \times 10$

THUJONE COMPONENTS

APPENDIX G

LIST OF COMPANIES CONTACTED AS

FOLLOW-UP TO THE MAIL QUESTIONNAIRE

TABLE 7. CONTACTS MADE IN FOLLOWING-UP THE QUESTIONNAIRE

COMPANY	ADDRESS	CONTACT	TELEPHONE	METHOD OF CONTACT	COMMENT
Amway Corp.	7575 E. Fulton Rd., Ada. MI.	R.W. Hamilton Group Leader	(616) 676-7697	Telephone	- user of fragrances
Ardor Ltd.	7 Penhurst Park, Point-Claire, P.Q.	R. Arsenault President	(514) 341-3785	Telephone	- trader
Biddle Sawyer Inc.	2 Penn Plaza, New York, N.Y.	Mr. Benveniste Exec. Vice-President	(212) 736-1580	Telephone	- trader
Centflor Mfgering Co.	545 W. 45th St., New York, N.Y.	R. Beller President	(212) 246-8307	Visit	- trader
Ciba-Geigy Corp.	P.O. Box 11422, Greensboro, N.C.	R.J. Patterson Manager of Adv. Tech.	(919) 292-7100	Visit	-Mfger of Agric. Chemicals
Elias Fragrance Inc.	999 East 46th, Brooklyn, N.Y.	F. Canonica Manager of Labs	(212) 693-6400	Telephone	- Mfger of fragrances
Firmenich (US) Inc.	P.O. Box 5880, Princeton, N.J.	R. Wardell	(609) 452-1000	Telephone	- Mfger of fragrances
Fritzsche Dodge and Olcott Inc.	76 Ninth Ave., New York, N.Y.	J.A. Rogers, Group VP B. Willis, Mgr. R & D	(212) 929-4100	Visit	- Mfger of fragrances
Fuerst, Day Lawson Ltd.	1 Leadenhall St. London, U.K.	M.D. Lawson		Telex	- trader
Givaudan Corp.	100 Delawanna Ave., Clifton, N.J.	J.T. Broderick VP Chemical Div.	(201) 365-8134	Telephone	- Mfger of fragrances
Haarmann & Reimer Corp.	P.O. Box 175, Springfield, N.J.	G.S. Clark Mgr. of Sales	(201) 686-3132	Visit	- Mfger of fragrances - trader

TABLE 7. Continued

COMPANY	ADDRESS	CONTACT	TELEPHONE	METHOD OF CONTACT	COMMENT
International Flavors and Fragrances Inc.	600 State Hwy.36, Hazlet, N.J.	J. Corley Materials Analyst L. Steinbach VP Purchasing	(201) 265-4500	Visit	- Mfger of fragrances and flavors
Paul Kaders, GmBH	Hamburg, West Germany	K.D. Protzen		Telex	- trader
J. Manheimer Inc.	47-22 Pearson Place, Long Island City, N.Y.	A.L. Manheimer	(212) 392-7800	Visit	- trader
Medallion Int. Inc.	944 Belmont Ave., North Haledon, N.J.	M.G. Boudjouk President	(201) 427-7781	Telephone	- trader
Mitsui & Co. (Canada)	Three Bentall Centre, Vancouver, B.C.	A.A. Ito Vice-President	(604) 681-5111	Visit	- trader
Naarden Int. USA Inc.	919 Third Ave., New York, N.Y.	Mr. Palya Purchasing agent	(212) 371-5300	Telephone	- Mfger of fragrances and flavors
PWF Div. of Hercules	33 Sprague Ave., Middletown, N.Y.	J. Abeshouse Dir. of Purchasing	(914) 343-1900	Telephone	- Mfger of fragrances
Polarome Mfger Co. Inc.	22 Ericsson Place, New York, N.Y.	F. Theile; B.H. Barash	(212) 334-1120	Visit	- trader
Proctor & Gamble Co.	P.O. Box 599, Cincinnati, Ohio	B. Corbett Buyer of Oils J. Grey, Buyer of Aromatics	(513) 562-1100 (513) 562-3091	Telephone	- user of fragrances

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COMPANY	ADDRESS	CONTACT	TELEPHONE	METHOD OF CONTACT	COMMENT
Quebec Government	Quebec City, Quebec	C. Lagace		Telephone	
Res. Institute for Fragrance Materials	375 Sylvan St., Englewood, N.J.	R. Opdyke Director	(201) 567-7523	Telephone	- tests safety of essential oils
Richardson-Vicks Inc.	P.O. Box V, Harboro, P.A.	A.J. Risi Dir. Materials Man.	(215) .672-4000	Visit	- user of cedar leaf oils
RJR Technicals Co.	Avoco Div., Winston-Salem, N.C.	B.M. Lawrence	(919) 777-4068	Visit	- expert in growth and production of essential oils
SCM Corp.	P.O. Box 399, Jacksonville, FLA.	B.J. Kane Div. of R & D	(904) 764-1711	Telephone	- processes terpenes
Synfleur, Div. of Nestle Co.	Empire State Bldg., New York, NY.	G. Bessinger Mgr. Trading Operations	(212) 279-5977	Visit	- trader
Synfuel Conversions	4346 Capilano Rd., N. Vancouver, B.C.	G.W. Pearman, Partner	(604) 986-2381	Visit	- interest in using distillation residue
The John D. Walsh Co.	65 Glen Ave., Glen Rock, NJ.	L. Serafini	(201) 444-3133	Telephone	- trader
US Dept. of Agric.	Foreign Agric. Service, Washington, D.C.	R. Dull	(202) 447-6049	Telephone	- source of statistic
Vioryl SA	Greece			Telex	- trader