The nitric acid test consists simply in adding a drop of concentrated, colorless nitric acid to a little of the dry powder, on a white plate. The results with procaine are shown in Table I, those with other local anesthetics in Table II. The melting points of the procaine samples were furnished by the Chemical Laboratory of the American Medical Association. It is noteworthy that the sample giving the color-reaction also had a melting point below that of all the other samples, *viz.*, 152–152.5 as against 153–155 degrees.

The positive reaction of orthoform and the negative result with all of the others, agree with the statement of Gadamer, *Lehrb. d. chem. Tokikologie*, Goettingen, 1919, page 490. He also examined a few further anesthetics that are not available at this time, and which are added to the table on his authority.

TABLE I.

RESPONSE OF PROCAINE SAMPLES TO NITRIC ACID TEST.

| Sample (code). | Color. | Melting point (° C.) |
|---|---|---|
| Novocaine, Hoechst, powder | Practically colorless | ..... |
| Novocaine-epinephrin tablets | Practically colorless | ..... |
| Novocaine, Koechl, tablets | Practically colorless | ..... |
| Procaine, R 121817 | Practically colorless | 153–154.5 |
| Procaine, M 82318 | Light yellow | 154–154 |
| Procaine, H | Light yellow | 153–154.5 |
| Procaine, A 89997 | Very slight brown | 153–154 |
| Procaine, A 12918 | Very slight brown | 153.5–154.5 |
| Procaine, R 82018 | Slight brown | 153–155 |
| Procaine, R 82318 | Slight brown | ..... |
| Procaine, R 121817 | Practically colorless | 153–154.5 |
| Procaine, R 82018 | Slight pinkish Brown | 154–155 |
| Procaine, R 82318 | Slight pinkish Brown | 153–154.5 |
| Procaine, R 5218 (three samples) | *Deep rose pink* | 152–152.5 |

TABLE II.—RESPONSE OF LOCAL ANESTHETICS TO NITRIC ACID TEST.

The following remained colorless, even on drying with the acid:

Anesthesin (2 samples)
Alypin (tablet)
Apothesin
Beta-eucaine lactate (2 samples) and hydrochloride
Cocaine
Cycloform (2 samples)
Euphthalmin
Holocaine (Gadamer)
Propaesin
Stovaine (Gadamer)

The following give color-reactions:

Nirvanin: yellow (Gadamer)

Orthoform-new: faint pink, changing rapidly to violet and finally red (distinction from other local anesthetics).

## SOME EFFECTS OF THE WAR UPON CRUDE DRUG IMPORTATIONS.*

BY CARL L. ALSBERG, ARNO VIEHOEVER, AND CLARE OLIN EWING.[1]

Few industries derive their raw materials from such varied sources as does the drug industry. Camphor from Formosa, cloves from Zanzibar, asafoetida

* Based upon an illustrated lecture delivered by C. O. Ewing before Scientific Section A. Ph. A., Chicago meeting, 1918.

[1] A contribution from Bureau of Chemistry, Department of Agriculture, Washington, D. C.

TABLE I.—SOME EFFECTS OF THE WAR UPON

| Commodity. | Grade to which wholesale prices apply. | 1913. Imports in 1000's. Lbs. | 1913. Declared value per lb. | 1913. Average wholesale price for grade quoted. | 1914. Imports in 1000's. Lbs. | 1914. Declared value per lb. | 1914. Average wholesale price for grade quoted. |
|---|---|---|---|---|---|---|---|
| Aloes | Curacao | 909 | 0.086 | 0.101 | 918 | 0.071 | 0.084 |
| Buchu | Short | 105 | 1.086 | 1.555 | 125 | 1.030 | 1.375 |
| Cinchona | Yellow quill | 3330 | 0.106 | 0.23 | 3655 | 0.127 | 0.23 |
| Coca | Truxcillo | 1176 | 0.118 | 0.285 | 712 | 0.128 | 0.241 |
| Ergot | Spanish | 224 | 0.931 | 1.556 | 186 | 0.529 | 0.956 |
| Gentian | ..... | 1797 | 0.049 | 0.069 | 2182 | 0.050 | 0.066 |
| Ipecac | Cartagena | 55 | 1.576 | 2.094 | '79 | 1.403 | 1.702 |
| Jalap | ..... | 277 | 0.161 | 0.225 | 209 | 0.115 | 0.169 |
| Licorice | Selected | 105033 | 0.017 | 0.099 | 86754 | 0.018 | 0.092 |
| Nux vomica | ..... | 2307 | 0.017 | 0.028 | 1891 | 0.017 | 0.037 |
| Opium, crude | ..... | 441 | 4.83 | 6.51 | 441 | 3.92 | 6.27 |
| Opium, powdered, etc. | Powdered | 49 | 7.94 | 7.79 | 32 | 6.42 | 7.64 |
| Orris | Verona | 358 | 0.104 | 0.129 | 580 | 0.124 | 0.146 |
| Rhubarb | High-dried | 122 | 0.136 | 0.211 | 181 | 0.123 | 0.161 |
| Sarsaparilla | Mexican | 301 | 0.136 | 0.157 | 225 | 0.165 | 0.263 |
| Senna | Tinnevelly | 2634 | 0.057 | 0.085 | 2455 | 0.070 | 0.080 |
| Tragacanth | Aleppo seconds | 1402 | 0.354 | 0.702 | 1302 | 0.354 | 0.90 |
| Vanilla | Mex. cuts | 1050 | 2.52 | 3.278 | 695 | 2.43 | 3.203 |
| Total | | 121570 | 20.224 | 25.104 | 102622 | 17.094 | 23.615 |
| Add for increased duty | | .... | .... | .... | .... | 3.048 | .... |
| Total | | .... | 20.224 | 25.104 | .... | 20.142 | 23.615 |
| Percentage comparison of declared price plus increased duty, 1913, as base | | .... | 100.0 | .... | .... | 99.5 | .... |
| Percentage comparison of wholesale price of grades quoted, 1913, as base | | .... | .... | 100.0 | .... | .... | 90.1 |
| Annual percentage comparison between declared value plus increased duty and wholesale grade price | | .... | 100.0 | 143.4 | .... | 100.00 | 112.2 |
| Percentage comparison of imports, 1913, as base | | 100.0 | .... | .... | 84.4 | .... | .... |
| Percentage comparison of imports, 1914, as base | | .... | .... | .... | 100.0 | .... | .... |

*Compiled by E. E. Stanford from "Foreign Commerce and Navigation of the United States," and "Oil, Paint, and Drug Reporter."

from Persia, rhubarb from China, sarsaparilla from Mexico, musk from Thibet, opium from Turkey, ergot from Russia and Spain, chamomiles from Germany, tragacanth from Asiatic Turkey, ipecac from Colombia and Brazil, cinchona from Java, senna from Egypt and India, ginger from Jamaica, benzoin from Siam and Sumatra, Peru balsam from Salvador, saffron from Spain and Italy, eucalyptus from Australia, lavender from France, attar of roses from Bulgaria, valerian from England—the list could be long extended. From sources so diverse as these, freedom of the seas is essential that each land may contribute its quota of supplies. Small wonder, then, that a world-embracing war, affecting so seriously the ordinary channels of trade, should have a far-reaching influence upon the amount and character of our imported crude botanicals.

At the outbreak of the war, with the first scurrying of ships to the protection of neutral harbors, for a short time imports almost ceased. Soon, however, the promise of a golden harvest brought forth the ships again, and the brief lull in importation passed. While imports of crude drugs decreased considerably, the actual tonnage decrease has probably been less than usually imagined. Some products have been cut off entirely; others have hardly been affected, and imports of some have even increased.

CRUDE DRUG IMPORTATIONS AND PRICES.

| 1915. | | | 1916. | | | 1917. | | | 1918. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Imports in 1000's. Lbs. | Declared value per lb. | Average wholesale price for grade quoted. | Imports in 1000's. Lbs. | Declared value per lb. | Average wholesale price for grade quoted. | Imports in 1000's. Lbs. | Declared value per lb. | Average wholesale price for grade quoted. | Imports in 1000's. Lbs. | Declared value per lb. | Average wholesale price for grade quoted. |
| 953 | 0.095 | 0.130 | 1598 | 0.095 | 0.129 | 1236 | 0.079 | 0.094 | 1231 | 0.077 | 0.095 |
| 121 | 0.959 | 1.450 | 95 | 0.900 | 1.218 | 101 | 0.851 | 1.257 | 51 | 0.837 | 1.275 |
| 3951 | 0.142 | 0.271 | 3967 | 0.196 | 0.287 | 2531 | 0.271 | 0.375 | 3132 | 0.248 | 0.55 |
| 1048 | 0.090 | 0.400 | 948 | 0.113 | 0.375 | 635 | 0.142 | 0.375 | 1059 | 0.169 | Nominal |
| 142 | 0.651 | 1.340 | 123 | 0.600 | 0.825 | 166 | 0.487 | 0.730 | 140 | 0.578 | 0.606 |
| 1022 | 0.054 | 0.081 | 788 | 0.080 | 0.202 | 1780 | 0.122 | 0.162 | 413 | 0.112 | 0.151 |
| 138 | 1.802 | 2.019 | 204 | 2.380 | 2.581 | 85 | 1.730 | 2.193 | 61 | 2.005 | 2.937 |
| 176 | 0.105 | 0.107 | 201 | 0.067 | 0.106 | 169 | 0.117 | 0.123 | 127 | 0.271 | 0.509 |
| 82289 | 0.019 | 0.125 | 52784 | 0.034 | 0.202 | 59399 | 0.037 | 0.245 | 27051 | 0.068 | 0.257 |
| 2245 | 0.023 | 0.063 | 4356 | 0.031 | 0.067 | 2446 | 0.035 | 0.100 | 2740 | 0.041 | 0.127 |
| 353 | 4.81 | 7.68 | 117 | 4.54 | 10.47 | 43 | 7.69 | 19.30 | 21 | 12.430 | 26.812 |
| 39 | 7.93 | 9.53 | 44 | 5.52 | 11.69 | 78 | 8.21 | 22.05 | 98 | 15.372 | 28.187 |
| 554 | 0.095 | 0.129 | 602 | 0.103 | 0.113 | 528 | 0.116 | 0.133 | 466 | 0.119 | 0.183 |
| 234 | 0.105 | 0.158 | 156 | 0.113 | 0.175 | 239 | 0.079 | 0.209 | 191 | 0.109 | 0.377 |
| 250 | 0.104 | 0.166 | 291 | 0.142 | 0.126 | 146 | 0.130 | 0.174 | 111 | 0.284 | 0.587 |
| 2180 | 0.096 | 0.159 | 2974 | 0.130 | 0.258 | 5161 | 0.167 | 0.215 | 3575 | 0.215 | 0.175 |
| 1025 | 0.346 | 1.669 | 1130 | 0.522 | 2.069 | 474 | 0.720 | 2.025 | 525 | 0.531 | 2.069 |
| 749 | 2.45 | 3.206 | 797 | 1.85 | 2.641 | 733 | 2.16 | 3.833 | 759 | 1.584 | 3.612 |
| 97469 | 19.876 | 28.683 | 71175 | 17.416 | 32.534 | 75950 | 23.143 | 53.593 | 41751 | 34.881[1] | 68.509[1] |
| ... | 4.065 | ... | ... | 4.065 | ... | ... | 4.071 | ... | ... | 4.018[1] | ... |
| ... | 23.941 | 28.683 | ... | 21.481 | 32.534 | ... | 27.214 | 53.593 | ... | 38.899[1] | 68.509[1] |
| ... | 118.4 | ... | ... | 106.2 | ... | ... | 134.6 | ... | ... | 193.5[1] | ... |
| ... | ... | 114.3 | ... | ... | 133.6 | ... | ... | 213.5 | ... | ... | 285.2[1] |
| ... | 100.00 | 119.8 | ... | 100.0 | 156.1 | ... | 100.0 | 196.9 | ... | 100.0[1] | 176.1[1] |
| 80.2 | ... | ... | 58.5 | ... | ... | 62.5 | ... | ... | 34.3 | ... | ... |
| 95.0 | ... | ... | 69.4 | ... | ... | 74.2 | ... | ... | 40.7 | ... | ... |

[1] Coca leaves not included in 1918 price computations.

With the object of indicating in a comparative way the effect of war conditions on drug imports and prices, a table (Table I) has been prepared showing the imports (in thousands of pounds), declared value per pound, and wholesale price of selected grades (from averaged quarterly quotations in the *Oil, Paint and Drug Reporter*, for the fiscal years 1913, 1914, 1915, 1916, 1917 and 1918), of eighteen well-known drug products—aloes, buchu, cinchona, coca, ergot, gentian, ipecac, jalap, licorice, nux vomica, opium (crude), opium (powdered, etc.), orris, rhubarb, sarsaparilla, senna, tragacanth, and vanilla. These products have been selected as the most important items on which import statistics are available; it is unfortunate that no Commerce and Navigation statistics are available for most other products, or even, in amount, for drugs or crude drugs as a whole. Amount of imports of these commodities for the years 1914–1918 are shown to be, respectively, 84.4%, 80.2%, 58.5%, 62.5% and 34.3% of those for 1913. During three-quarters of the last pre-war year, 1914, increased or new tariff duties were in effect upon buchu, coca, ergot, gentian, licorice, opium, sarsaparilla, and vanilla. Imports of these commodities, with the exception of buchu, gentian, and crude opium, showed a marked falling off from the figures of 1913, as did, indeed, several other products not affected by the tariff.

If 1914 be taken as a base, the percentages shown by the four war years are 95%, 69.4%, 74%, and 40.7%, respectively.

The total average cost of a pound each of these widely varying items since 1913 has shown increases only in two years, 1917 and 1918, of 14.4 percent and 72.5 percent, respectively. To the buyer's cost, however, must be added new and increased duties on several of the products effective October 1, 1913. Without enumerating these specifically, it may be said, for the dutiable products listed, the total increase over the tariff of 1909 amounts to a trifle over $4.00. As these duties applied during only a portion of the year 1914, an amount proportionate to that period of the year has been added in making up the buyer's total. As this tabulation is chiefly concerned with recent factors affecting trade, previous tariff rates (Act of 1909) have not been included.

These increases bring the cost of 1913 and 1914 to virtual equality. Other increased costs are represented by increased freight rates, insurance, cost of labor, etc. Unfortunately, these cannot be included in this tabulation.

It would be interesting to compare the cost price, in so far as it is represented by the invoice cost plus increased duty, with the wholesale price, but this cannot be done exactly, as two or more grades of these commodities are usually quoted. An approximation may, however, be made by using for this purpose the most common grade or, in the case of widely variable items, like vanilla, one which seems to represent an approximate mean of the prices of the chief varieties. An increase of wholesale price on selected grades over the 1913 price is noted in every year save 1914; in 1917 the wholesale price is 113.1 percent above that of 1913, while the invoice cost plus increased duty for the commodities as a whole has increased but 34.6 percent. For that year (1917) wholesale prices on several grades are 96.9% above the invoice cost plus duty, while in 1913 the difference was but 24.1 percent and in 1914 only 17.2 percent.

The year 1918 witnessed a further drastic cut of imports, which amounted to only 34.3 percent of those of 1913. While all commodities showed the effects of the war, this large percentage decrease is chiefly due to import restrictions and other adverse conditions affecting the largest import of all—licorice root. During that year coca leaves remained strictly nominal on the American market; while imports were even larger than the average of previous years, presumably no supplies reached the open market. In the 1918 price computations, therefore, its commodity has not been included. Excluding coca leaves, the total price of the given grades was no less than 185.2 percent above that of 1913, and 76.1 percent above the invoice-plus-duty price, the latter being, however, 93.5 percent above 1913.

The shortage of certain supplies of crude drugs has proved a considerable stimulus to drug cultivation, both in America and elsewhere. Numerous publications regarding drug cultivation have appeared in various journals, and the subject may be here only briefly referred to. The principal drugs now cultivated in America include belladonna, digitalis, cannabis, hyoscyamus, and others. Of foreign nations, Japan has perhaps most rapidly taken up drug cultivation. Japan now furnishes us considerable supplies of matricaria, castor beans, mustard seed, and valerian. Most striking, however, is her rapid increase in exports of insect flowers. Prior to the war, this product entered the United States chiefly from

Europe, in amounts insufficient to receive mention in Commerce and Navigation statistics. In 1917, over 1,500,000 pounds were imported, mostly from Japan.

War conditions, of course, soon made themselves felt in sources and routing of supplies. Where formerly the major portions were transshipped through the drug markets of Hamburg, London, Amsterdam, Antwerp, and Marseilles, now much of the dealing was direct. Shipments began to arrive from little-known ports of or near the country where the materials were gathered and importers were forced to adjust their business methods to the changed conditions. As existing stocks of the remaining accessible middlemen decreased, more and more new direct connections had to be established with dealers in small, oftentimes, remote places. Goods began to be received in smaller lots, partly because small dealers at difficultly accessible points could not accumulate larger amounts before filling orders, and partly because the ever-widening influence of the war and the insistent demands of war-born industries called labor, especially agricultural labor, to other tasks more remunerative than the gathering of drugs. The collection of such products, frequently in the hands of ignorant or uneducated persons, naturally has suffered. Many of the collectors in the older collecting regions no doubt are unused to such pursuits, and in their inexperience they are apt to collect material carelessly or to dry it improperly. Such conditions are even more apt to obtain in regions where crude drugs have not hitherto been collected. Other errors may probably be attributed to the fact that merchants unfamiliar with and unequipped to handle drug products have undertaken to supply much desired articles.

Adulteration has taken chiefly two forms—the collection of authentic material of poor quality and the collection or addition of spurious material. In general, we are of the opinion that intentional sophistication is comparatively rare, although cases do occur occasionally. It is hard to believe, for instance, that decorticated cardamon seed, containing pebbles which simulate the appearance of the seeds themselves, is not an example of intentional adulteration, although the seeds of certain closely related *Amomum* species, which have also been observed in small amounts, are very possibly accidental. As a further example of unquestionable wilful adulteration may be mentioned "aniseseed" containing up to 75 percent of exhausted fruits; but most surprising of all was a shipment of aspidium, the bales of which contained alternate layers of old worthless material and fresh, newly-gathered material of strictly U. S. P. quality. The exporter had of course taken the precaution to place some of the latter at both ends of the bales.

The low quality of some material offered for entry is no doubt due to careless collection; instances of this type are insufficiently washed roots—sarsaparilla, dandelion, valerian; leaves containing excessive stems—buchu, sage, senna, thyme; seeds containing chaff, stems and other foreign material—mustard, poppy, staves-acre, etc. Under this class also must be placed moldy goods; it is hard to find shipments of areca nuts and nutmegs free from mold. African ginger is another bad offender, and the same is true of ergot and orris root.

With regard to the offering of wholly spurious material, we are of the opinion that this also may be accidental, as well as intentional. Oftentimes medicinally unlike drugs have a somewhat similar appearance and may be mistaken for the true material by an ignorant collector, a case in point being *Eupatorium glutinosum* Lamarck, which has been offered as matico. In some instances, where the ap-

pearance of the adulterant is so unlike that of the true material that no confusion could possibly arise, it would seem that the collector had found something apparently as valuable for similar purposes as the true material and offered it as such; *Macrotomia cephalotes* D. C., which has been offered as alkanet is an example of this type. Thus it happens that spurious material which arrives may not be without value. Oftentimes, however, it is worthless, and the importer who may perhaps have been compelled to accept a sight draft with the bill of lading, is unfortunately subjected to an unpreventable loss.

These rapidly appearing new products are a source of never-ending interest and oftentimes joy to one interested in the botany and chemistry of drug plants and new sources of drug supplies, and it is chiefly to some of these products that we wish to call your attention in somewhat greater detail, perhaps, than can be accorded them in the more impersonal Service and Regulatory Announcements of the Bureau of Chemistry.[2],[3] Judging from data at present available, these products may be divided into five classes, as follows:

I. Material containing toxic foreign matter.
II. Material of value as substitutes for recognized products.
III. Material unsuitable for use as substitutes for recognized products, but valuable for other purposes.
IV. Material of uncertain value, requiring further study.
V. Material of no known value.

## *Class I.*

*Caraway.*—Several shipments of caraway have been offered for importation which contained a considerable number of fruits infected with a fungus-like growth resembling ergot. Although no information was available as to whether this type of fungus was as poisonous as the common ergot occurring on rye, the Bureau considered it of such a character that the importation of the shipment was not permitted until the objectionable material was removed.

*Cumin.*—One shipment of cumin, offered for importation, also contained fruits more or less attacked by the same fungus.

This ergotlike fungus can be readily detected, even in fruits only slightly infected, with the chitin test described in considerable detail by one[4] of the writers.

*Marjoram.*—In quite a number of instances the leaves of *Coriaria myrtifolia* have been found in shipments of marjoram, some samples containing as high as 8 percent. The leaves of the *Coriaria* had been so finely cut as to destroy any resemblance to their original form, which leaves no doubt that the adulteration was intentional. According to Kobert[5] and Schmiedeberg,[6] the adulterant mentioned contains a poisonous principle, *coriamyrtin*, which is similar in action to picrotoxin. A fatal case of poisoning as a result of eating omelets garnished with *Coriaria* sprouts is reported in *Bull. de Pharm. de Sud-Est*, 1910, 29 (through *Apoth. Ztg.*, 1910, 455).

A quick, rough test to detect this adulterant in marjoram follows: Place about a gram of the sample in a 6-inch porcelain dish, add about 200 cc. of water, and finally add about 5 drops of a 10 percent iron chloride ($FeCl_3$) solution. A light yellowish green color of the liquid is produced by pure marjoram, but when *Coriaria* is present the color becomes a decidedly darker dirty green, the intensity naturally depending upon the amount of *Coriaria* present and the time

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[2] S. R. A., *Chem. Index*, (1–22), 1918; S. R. A., *Chem.*, 23, 1918.

[3] The botanical work herein reported was largely done by or with the help of Mr. J. F. Clevenger.

[4] A. Viehoever, "On the Detection of Mold in Drugs, Foods, and Spices, with Special Reference to a Specific Stain," THIS JOURNAL, 6, 518–24 (521), 1917.

[5] *Lehrbuch der Intoxikationen*, 1906, 1095.

[6] *Pharmakologie*, 1909, 286.

of standing. The coloration is due to the presence of a large amount of soluble tannin. After standing a few minutes the edge of the particles of *Coriaria* leaves become conspicuously blackened and can be picked out readily. These particles are entirely flat, distinctly thicker than the leaves of marjoram, somewhat glabrous, and have a brighter green color. Of especial importance in distinguishing them from marjoram is the absence of hairs and the fact that surface sections of these leaf particles show striations of the epidermal cells, this latter characteristic being especially pronounced in those cells immediately surrounding the stomata.

*Senna.*—An adulteration of senna which was reported in literature as long ago as 1836[7] is *Tephrosia appolinea.* Of late years, however, its use for this purpose appears to have been discontinued and no mention is made of it in recent literature. We were very much surprised, therefore, to find it again in several importations of senna leaves. The leaves are obovate, often obcordate, and may, furthermore, be distinguished from senna by their smaller size and pinnate venation. The fruit pods, which are 2 to 3 cm. long and about 3 mm. wide, are also of service in detecting this adulterant. A number of *Tephrosia* species have been reported to contain a toxic glucoside, *tephrosin*, and to have been used as fish poisons. Senna containing this adulterant was denied admission.

## *Class II.*

*Aconite.*—The most important product which has been imported for aconite is the so-called Japanese aconite (*Aconitum fischeri Reich*). The material which generally consists of mother tubers (with stem bases) and daughter tubers (with buds) may be distinguished macroscopically from the official aconite (*Aconitum napellus L.*) by their much smaller size and weight, less wrinkled and not twisted appearance, more or less short, conical shape, generally more mealy condition, and microscopically by the different arrangement of the fibro-vascular bundles, which are usually not so markedly star-shaped. According to Makoshi[8] they contain no aconitine but either japaconitine, possibly an isomer of aconitine, or jesaconitine. He reports both alkaloids to have a physiological action similar to that of aconitine and that they may, in fact, be even more active.

Since the daughter tubers are considered by some authors to be more desirable, and are specified by the Swiss, German and Belgian pharmacopoeias, an examination was made of the Japanese aconite to determine the relative amounts of ether-soluble alkaloids in both mother and daughter tubers. The following results were obtained:[9]

| | Composition. | | Alkaloids present. | | |
|---|---|---|---|---|---|
| Sample. | Mother. | Daughter. | Mother. | Daughter. | Whole sample (calculated). |
| 1..... | 72% | 28% | 0.41% | 0.46% | |
| | | | 0.40% | 0.45% | |
| | | | Av. 0.405% | Av. 0.455% | Av. 0.42% |
| 2..... | 59% | 41% | 0.32% | 0.49% | |
| | | | 0.33% | 0.49% | |
| | | | Av. 0.325% | Av. 0.049% | Av. 0.39% |

The analyses showed that while in general the daughter tuber was superior to the mother tuber, the alkaloidal content of both was below the U. S. P. requirement for *Aconitum napellus.* In connection with this product the interesting statement is made by Zörnig[10] that Japanese aconite has been favored by manufacturers of extracts of aconite, since it contains very little resinous matter. *Aconitum napellus,* however, is the only species of aconite official in any country so far as we can find, including Japan.

Another species recently substituted for aconite is *Aconitum chasmanthum* Stapf., an Indian species.[11] We feel, however, that the name Indian aconite should not be applied to it since the principal variety of Indian aconite is *Aconitum ferox* Wall., to which the term is generally

[7] *Annalen der Pharm.*, 1836, 94–8.

[8] *Archiv. de Pharm.*, 1881, 3, 47, 177.

[9] *Analyst*, M. G. Mastin.

[10] *Die Arzneidrogen*, 1909, I, 659.

[11] Identified by C. J. Zufall.

referred. *Aconitum chasmanthum* is generally smaller than the official aconite, being about 2 cm. long and about 0.75 cm. in diameter; it is less wrinkled and the rootlet stubs are usually clustered at the basal end. Its fracture is lighter in color and its texture less tough and resinous.

With regard to the alkaloidal content, Dunstan and Andrews[12] state that it "contains indaconitine, an alkaloidal intermediate between aconitine and pseudaconitine." Cash and Dunstan[13] have pointed out that its physiological action differs in degree only, and not in kind, from these alkaloids. They state "Indaconitine . . . . . may therefore be substituted for aconitine and pseudaconitine for internal use, indaconitine being administrable in the same dose as aconitine." The sample in question contained about 0.7 percent of ether-soluble alkaloids.[14] Of interest are also the results of Frazer's experiments, who compared the action of official aconite with that of other aconites native to India.[15]

*Alkanet.*—A specimen offered for entry as "Alkanet" proved, upon examination, to be the root of *Macrotomia cephalotes* D. C., so-called "Syrian Alkanet." It is much larger than the genuine alkanet, *Alkanna tinctoria* Tausch.; it occurs in pieces from 20 to 40 cm. long and from 2 to 5 cm. thick, whereas alkanet is about 1 to 1.5 cm. in diameter and is usually 10 to 15 cm. in length. It is black-violet in color and somewhat metallic in appearance, whereas alkanet is of a dull maroon color. It has a distinctly spiral twist, resembling a twist of tobacco, whereas alkanet is only slightly twisted.

Chemical examination showed it to contain about 9 percent of an extract very similar to that of true alkanet, which is considerably more than is generally reported in true alkanet (5 or 6 percent). The coloring extract, as is also true in the case of alkanet, consists of at least two chemical individuals, and both extracts appear to be very similar in nature. In view of the fact that in the so-called "Syrian Alkanet" the extract was much larger in amount than in true alkanet, and possessed equivalent tinctorial strength, it would appear to be a valuable substitute for the latter. An extract prepared with 95 percent alcohol, diluted with water to about 50 percent concentration of alcohol, gave very satisfactory results in the Pharmacognosy laboratory and in the Microbiological laboratory of the Bureau of Chemistry in the staining for microscopic observation of sections containing fats (soya beans, castor beans, yellow mustard seed, etc.) and resins (podyphyllum rhizome and white bryony root).

Further details regarding this interesting product have recently appeared in the Journal of this Association.[16]

*Buchu.*—The official species of buchu are commonly known as "Long" buchu (*Barosma serratifolia* (Curtis) Willdenow), and "Short" buchu (*Barosma betulina* (Thunberg) Bartling and Wendland). A non-official species which has recently appeared on the market is the so-called "Oval" buchu (*Barosma crenulata* Hook. var. *latifolia*). The odor of the leaves is strong and even more agreeable than that of certain samples of the official species that we have examined. It is of interest in this connection that the Japanese Pharmacopoeia recognizes the leaves of *Barosma crenulata* as buchu leaves. While data obtained by Schimmel & Company[17] indicate that the volatile oil separated from *Barosma crenulata* contains small amounts of diosphenol (buchu camphor), it is different from those of the official species.

Two other adulterants which, however, do not appear to be of value as substitutes for buchu are *Empleurum serratulatum* Sol. and Ait., offered as "Long buchu," and *Barosma pulchellum* Bartl. and Wendl., offered as "Short buchu." The sizes of the leaves are distinctly different from those of the official species. The aroma of *Empleurum serratulatum* and *Barosma pulchellum* is distinctly different from that of the official species. We have as yet been unable to make any extended examination of the volatile oil of *Barosma crenulata* Hook var. *latifolia*, which appears to be the most promising of the three products.

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[12] "Contribution to Knowledge of Aconite Alkaloids, "*Trans. Chem. Soc.*, 87, 1620–36, 1905.

[13] *Proc. Roy. Soc.*, 1905), 468.

[14] *Analyst*, S. Ginsburg.

[15] "A Contribution to the Pharmacology of *Aconitum heterophylloides*, *A. nagarum* and *A. napellu,s*" *J. Pharmacol. and Exp. Therap.*, 9, 43–56, 1917.

[16] Ewing and Clevenger, "So-called 'Syrian Alkanet,' *Macrotomia cephalotes* D. C.," THIS JOURNAL, 7, 191–4, 1918.

[17] *Semi-Annual Report*, October 1911, 23.

*Coriander.*—Some importations of coriander seed have consisted of fruits differing in physical appearance from the Pharmacopoeial description. They are larger, have a more oval appearance, and in general yield less volatile oil than the pharmacopoeial article. Growing experiments are being carried on to determine their botanical source. At present we are unable to state whether they belong to a distinct species or are merely a variety of the official *Coriandrum sativum* L. The product appears in the trade as Bombay or Indian coriander and appears to have value. One sample yielded about 0.2% of a volatile oil having a specific gravity at 25°/25° of 0.8726, optical rotation (100 mm. 23°), 12.73°.[18] The oil contained over 50 percent of coriandrol, and also a very small amount of citral. No pinene was detected with the small amount of oil available. The oil complied with the U. S. P. requirements for oil of coriander, and is apparently somewhat similar in composition.

*Horehound.*—In quite a number of instances the young herb of *Ballota hirsuta* Benth. has been substituted for true horehound, *Marrubium vulgare* L. The material is very closely related to horehound and resembles it so closely in appearance that it is difficult to point out striking macroscopical distinguishing characteristics. With the hand-lens or microscope, however, the following characteristics are noted:[19]

(1) The tufted hairs of the leaves of *Marrubium vulgare* are usually curved or bent and almost sessile; those of the leaves of *Ballota hirsuta* are usually straight and are somewhat elevated by a multicellular basal stalk.

(2) The calyx of *Marrubium vulgare* has long, recurved, subulate teeth, while that of *Ballota hirsuta* has shorter, acute or obtuse teeth.

(3) The hairs of the inner surface of the calyx of *Ballota hirsuta* contain crystals probably consisting of calcium oxalate; those of *Marrubium vulgare* do not.

We have been unable to find any chemical data regarding *Ballota hirsuta* and have as yet not found an opportunity to study it ourselves. However, the similarity of the two species was so striking that a small amount of candy was made from an infusion of the material. The flavor was not at all unpleasant, and very closely resembled that of horehound. When larger amounts of the material are available it will be interesting to determine the nature of the volatile oil and to ascertain whether or not the bitter substance which is present consists of marrubiin, the bitter principle of horehound.[19]

*Hyoscyamus.*—Within the past two years there have been increased offerings of *Hyoscyamus muticus* which, although unsuitable for use as a substitute for *Hyoscyamus niger*, appear nevertheless to have considerable commercial value. It appears that this species, especially plants grown in Egypt, contain considerable amounts of hyoscyamin in a form which can easily be obtained in the crystalline state. It is reported not to contain scopolamine, the other active principle of the official *Hyoscyamus niger* L. It may be distinguished from *Hyoscyamus* by its characteristic branching non-glandular hairs, which occur on both stems and leaves.

*Jalap.*—A very interesting product which has lately appeared on the market is Piptostegia root (*Piptostegia pisonis* Mart.), sometimes called "Brazilian Jalap" The material is related to true Jalap, *Exogonium purga* (Wenderoth) Benth. It may readily be distinguished from true jalap in that it occurs in commerce in the form of transverse circular or oval sections, varying from about 3 to 8 cm. in diameter and from about 0.3 to 0.8 cm. in thickness. The pieces are marked with several concentric rings, and aside from the pale grayish brown tint and the presence of numerous dots of translucent, pale resin on the surface, bear considerable resemblance to commercial white bryony root. True jalap tubers generally occur in the whole state. The material contains up to 20 percent or more of an active purgative resin which, however, is unlike the resin obtained from true jalap. This product has been recently described at somewhat greater length in the journal of this Association.[20]

*Licorice Root.*—One of the crude drugs in largest demand at the present time, the supplies of which have been very adversely affected by the war, is licorice. This product has heretofore

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[18] *Analyst*, J. F. Darling.

[19] For further details see Ewing and Clevenger, "*Ballota hirsuta*, an Adulterant of Horehound," THIS JOURNAL, 8, 273–275 (1919).

[20] Ewing and Clevenger, "Piptostegia Root (*Piptostegia pisonis* Mart, So-called 'Brazilian Jalap),'" THIS JOURNAL, 1918, 855–95.

been largely supplied through Spain and Russia. At the present time, however, supplies of a new species are also being received from Asia. The material was obtained from *Glycyrrhiza uralensis* Fischer, known as "Asiatic Licorice" (Chuntschir licorice). According to the literature, it contains about the same amount of glycyrrhizinic acid as Spanish and Russian licorice. When tested by the U. S. P. method it yielded 27 percent of extractive to hot water, which is considerably in excess of the U. S. P. requirement of 20 percent. The samples that we have observed were for the most part of good quality, and the material appears to be a valuable commercial product.

*Sage.*—The foreign supplies of true sage, *Salvia officinalis* L., have been very largely shut off and the material now being offered consists of Greek sage, *Salvia triloba* L., and Spanish Sage, *Salvia lavandulaefolia* Vahl. *Salvia lavandulaefolia* is official in the Spanish pharmacopoeia, as well as *Salvia officinalis*. Tschirch[21] expresses the opinion that it may be only a variety of *Salvia officinalis*, namely, *Salvia officinalis* var. *hispanica* Boiss. It has an agreeable odor but is somewhat camphoraceous, and for that reason will probably find less commercial demand than Greek sage, which resembles in flavor very much the true sage.

These forms, while very closely related to true sage, differ in appearance and flavor and are well recognized by the trade as distinct forms. Greek sage may be distinguished from true sage by the usually broader, shorter, thicker, entire leaves, short petioles, and by its more wooly appearance. Spanish sage may be distinguished by its smoother, considerably smaller, entire leaves and relatively long petioles; neither Greek sage nor Spanish sage possesses the crenulate edge and the strong venation characteristic of true sage.

*Scammony.*—True Scammony, *Convolvulus scammonia* L., appears to be no longer available in commercial quantities, and it seems probable that the product now listed as scammony in the trade journals is really Orizaba root, *Ipomoea orizabensis* Ledanois, sometimes improperly called "Mexican Scammony." This product contains an active purgative resin in larger amounts than true scammony, and has of late been imported from Mexico in large quantities. It appears to be a valuable product and no doubt will secure for itself an important place in our materia medica.

Heinrich[22] has recently shown that the active portions of Orizaba-resin, Jalapin, and of Jalap-resin, Convolvulin, are glucosidic substances with saponin character. Of the two, Jalapin was more strongly hemolytic.

*Tragacanth.*—A material which has come upon the market in considerable quantity within the last few years is Karaya gum, sometimes invoiced as Kadaya, Maura, Shiraz, or Indian gum. The last name, however, has been applied to other gums of India, and we do not consider it a proper name for this material. Karaya gum is obtained chiefly from *Sterculia urens* Roxb. and *Cochlospermum gossypium* D. C., and also from other closely related species of *Sterculia* or *Cochlospermum*. It occurs in irregular, rounded, translucent lumps of a pale buff color; it is said never to occur in the ribbon-like, whitish or light brown bands characteristic of true tragacanth. Its presence may be detected by U. S. P. IX tests for the purity of gum tragacanth, where it is referred to in a number of tests as Indian gum. It appears to have certain valuable properties[23] and has already found application in a number of ways as a substitute for tragacanth, although there is no doubt but that it is inferior to the official drug.

## *Class III.*

*Belladonna.*—A notable feature about a shipment of 3 bales of belladonna leaves recently offered for entry was that two bales consisted of genuine material, while the other consisted of the leaves of *Solanum nigrum* L. The substitution of this plant for belladonna may be due to the fact that the common names of the plants are similar, belladonna being called Deadly Night Shade, and *Solanum*, Black Night Shade, and sometimes, erroneously, Deadly Night Shade. Since this species contains solanine, and not atropine, it is not a suitable substitute for the official drug.

*Mustard.*—The mustard situation since the cutting off of European supplies has been exceedingly acute and has resulted in great stimulation of the importation of Oriental and Indian

[21] *Handbuch der Pharmakognosie*, 1913, II, 1024.

[22] Heinrich, "Biological Behaviour of Convolvulin and Jalapin," *Biochem. Zeitschr.*, 38, 13–34, 1918.

[23] Ewing, "Karaya Gum, an Adulterant of Tragacanth," THIS JOURNAL, 7, 787–90, 1918.

species. A number of these have proven of value, but others appear to be unsuited for use as mustard substitutes. Of the latter, the most noteworthy has been Chinese colza, *Brassica campestris* var., *sativa annua chinensis* Lund and Kiaerskou, *Brassica chinensis* L.[24] and Indian tori, *Brassica napus* var. *dichotoma*. An examination of Chinese colza showed it to contain on the average about 0.4 to 0.5 percent of a volatile oil of different character than that obtained from the official species, *Brassica nigra*. It had an odor more nearly resembling that of cabbage and did not have the typical mustard oil effect upon the eyes and nose, nor did it blister the skin. In general, the Chinese colza more nearly resembled the rapes than the mustards; this was also true of the Indian tori. The former is of value as greens and both are valuable as forage and oil seed crops. Two products, however, have proven to be of value as mustards—Chinese mustard, *Brassica juncea* L., and Japanese mustard, *Brassica cernua* Thunberg, a variety of *Brassica juncea;* both of these have properties similar to the official *Brassica nigra* L. Koch. Studies of these products are at present under way.

## *Class IV.*

*Chamomile.*—A crude drug product which is generally imported in large amount is German chamomile flowers (*Matricaria chamomilla* L.). The usual sources of supply having been largely shut off, this product has been subjected to considerable adulteration, the most noteworthy adulterant perhaps being flowers of dog fennel, *Anthemis cotula* L. This adulterant has been found in amounts as high as 25 percent, or more. It is fairly closely related to *Matricaria* and some of the chemical data in the literature suggest that it possibly might have somewhat similar properties. As a matter of fact, it was recognized in the U. S. Pharmacopoeia from 1820 to 1880. It is possible, then, that it may not be without value, but appears to be inferior to German chamomile, and it is obvious that it is improperly offered and sold as such.

Another adulterant of German chamomile which has been offered for importation is the flower heads of wild Roman chamomile, *Anthemis nobilis* L. This adulterant also resembles somewhat German chamomile. The flowers which are said to have been obtained from wild growing plants have only one row of ligulate florets, the whole of the disk florets being yellow and tubular. Flowers of this type are called single chamomiles; double chamomiles, which are the familiar form, are the cultivated flowers in which all or nearly all of the yellow tubular florets have become converted into ligulate ones. The latter were official in the U. S. P. VIII. They are larger and whiter and are commonly preferred by the trade, although the tubular florets of the wild plants are more odorous and somewhat more bitter than the ligulate ones, and are said to have the most powerful medicinal properties.[25]

It appears that this substitute also may not be without value, inasmuch as it seems, from the information available, that the material contains the same active constituents as the cultivated variety formerly official. It is obvious, however, that if used it should be offered and sold as "Wild Roman Chamomile." The flowers of both adulterants have solid chaffy receptacles, whereas those of *Matricaria chamomilla* have naked, hollow receptacles. Both substitutes may be readily detected by these means.

*Couchgrass.*—Bermuda grass (*Cynodon dactylon* L.), has been substituted quite frequently of late for true Couchgrass (*Agropyron repens.*). Considerable work has been done on the chemical properties of *Agropyron repens*, and two glucosides, one a vanillin glucoside, and the carbohydrate *triticin*, have been isolated. In an early work[26] *cynodon* is reported as an active substance, occurring in the rootstock of *Cynodon dactylon*. Tschirch[27] considers *cynodon* as identical or similar to asparagin. We understand that Bermuda grass has been used in the southern part of Europe for similar purposes as couchgrass in central Europe, and it is reported as occurring in the trade under the names *Rhizoma cynodontis, Rhizoma Graminis italici*, or *Rhizoma Graminis dactyli*. The lack of starch and the considerable size of the endodermis cells characterize the rootstock of *Agropyron repens*, while the rootstock of *Cynodon dactylon* contains considerable

[24] Viehoever, Ewing and Clevenger, "Studies on Brassicas I. Chinese Colza (*Brassica campestris* var. *chinensis Toleifera m. f.*)" (unpublished manuscript).

[25] Bentley and Tridelemen, 3. 154, 1880.

[26] Semmola, *Chem. Jahrsb.*, 1845, 535.

[27] *Handbuch der Pharmakognosie*, 2, 223, I, 1912.

starch and smaller endodermis cells. Comparison with *Agropyron repens* rootstocks furthermore shows that the rootstocks of *Cynodon dactylon* have thinner, longer scales, often, or usually pubescent.

*Digitalis.*—In a number of instances *Digitalis thapsi* L. has been offered for *Digitalis purpurea* L. This substitute grows wild in Spain, as does also *Digitalis purpurea*, which is quite similar to it. It may be distinguished by the hairs, which are of one sort, glandular, long, stalk, several-celled, with 1- or 2-celled glandular head, whereas the hairs of *Digitalis purpurea* are of two sorts, usually long, simple, 2-8 celled, some cells frequently collapsed, glandular hairs few, much shorter, with 1- or 2-celled stalk and 1- or 2-celled glandular head. A notable fact regarding the samples we observed was the somewhat yellowish tint, due perhaps to faulty curing or storage.

So far as we are aware, *Digitalis thapsi* is not recognized in any pharmacopoeia. Experiments reported in the literature[28,29] indicate that it has considerable activity, but it has also been intimated that the pharmacological action is not identical with that of *Digitalis purpurea*. Since, however, the drug appeared to be worthy of further investigation, plants for this purpose were planted in March, 1917.

## *Class V.*

*Arnica flowers.*—A large number of samples offered for import as "Arnica flowers" have been found to consist of the flower heads of *Inula britannica* L. The ligulate flowers are considerably smaller in length and width than those of the true arnica flowers, *Arnica montana* L. The veins in the ligulate flowers of *Inula britannica* number 4, while 7 to 12 are reported in the literature for arnica flowers. The young achene (undeveloped fruit) is 1 mm. long, whereas that of arnica is 5 to 7 mm. in length. The receptacle is smooth in *Inula britannica* but hairy in true arnica. An abundant pappus is developed in both species, which is the cause of a somewhat similar appearance of the two products.

Nothing appears to be known as to the chemical constituents of this product. It is not official in any pharmacopoeia, and its medicinal value is not known.

*Dandelion Root.*—In several instances a root, possibly that of a species of *Lactuca* or *Sonchus*, has been substituted for the root of *Taraxacum officinale* L. The adulterant is characterized by its tracheae, which are arranged in radial rays usually one cell wide, alternating with medulary rays two or three cells wide. We have been unable to find any data regarding the chemistry of this adulterant, and, as far as we are aware, it does not appear to be a suitable substitute for dandelion root.

*Fennel.*—Several shipments of fennel seed have proven, upon examination, to be the fruits of wild fennel, *Foeniculum piperitum* Sweet. The fruits are small and their flavor is distinctly inferior to the official fennel *Foeniculum vulgare* Miller. This species is not cultivated and may be distinguished from *Foeniculum vulgare* by its very much smaller size and the decidedly bitter taste and flavor of its volatile oil. The inferior quality is especially noticeable when an examination is made of the distilled volatile oil.[30] From the data available, this product appears to be an unworthy substitute for the U. S. P. article.

*Ipecac.*—The increased demand for ipecac has resulted in the offering of quite a number of other materials under this label. Among these are *Heteropteris pauciflora* Juss., *Ipecacuanha fibrosa* and an *Ionidium* species. True ipecac has calcium oxalate raphides, numerous starch grains and contains no groups of bast fibers in the cortex. *Heteropteris pauciflora* contains no starch and has a normal wood structure; stone cells and calcium oxalate rosettes are present in the bark. The *Ionidium* species contains no starch; small stone cells, when present, occur in the bark, as do also prismatic crystals of calcium oxalate. *Ipecacuanha fibrosa* may be differentiated by the presence of groups of bast fibers arranged tangentially. None of these adulterants, as far as we are aware, are mentioned in any pharmacopoeias, nor do they contain the active principles of the official drug.

*Matico.*—*Piper angustifolium* Ruiz et Pavon. is another product which has been much adulterated. In some instances the leaves of a closely related *Piper* species, *Piper bredemeyri*

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[28] Holmes, "Spanish Digitalis," *Pharm. Jour. and Pharm.*, (ser. 4), 1917, 351, 399.

[29] Farwell and Hamilton, "*Digitalis thapsi* L," *Am. Journ. Pharm.*, 1917, 147–154.

[30] *Analyst*, H. B. Mead.

Jacq.,[31] have been substituted, and these, no doubt, may have a limited application as a substitute for matico. One shipment, however, upon examination, proved to be obtained from an altogether unrelated species, *Eupatorium glutinosum* Lam. At first glance the adulterant has an appearance somewhat resembling matico, due to the fact that both species have leaves glabrous and coarsely bullate on the upper surface, but comparison with authentic material readily discloses obvious differences. The leaves of *Eupatorium glutinosum* pack together in rather a gummy, spongy fashion, and are much less brittle than those of the recognized matico. The leaves of matico are alternate, entire, mostly sessile, and are pubescent on the lower surface, whereas those of the adulterant are opposite, serrate, have a petiole one-half to one inch long, and are very wooly on the lower surface. The flowers, a few of which are generally present, offer further means of identification; those of matico occur in long spikes, while those of the adulterant occur in cymosepaniculate composite heads. The material yielded about 0.15 percent of a volatile oil resembling that of boneset, *Eupatorium perfoliatum* of the National Formulary. This adulterant has previously been described in somewhat greater detail in THIS JOURNAL.[32]

*Stramonium.*—In a number of instances importations of "Stramonium leaves" have been found to consist of the leaves of cockle bur, *Xanthium strumarium* L.[33] The leaves have about the same size and appearance as stramonium leaves, and the fruit also is covered with small thorns which simulate somewhat the fruit of stramonium. They differ, however, from stramonium leaves in that they are dentate and pubescent at the margin; under the microscope they show short tricellular hairs which enclose calcium carbonate crystals, as well as other small 7-celled hairs. Calcium oxalate crystals are absent in the leaves of the cockle bur, whereas they are abundant in stramonium leaves. Examination of the material showed the absence of the alkaloids characteristic of the genuine drug. The material therefore is not a suitable substitute for stramonium.

The foregoing[34] represent only a portion of the many interesting products which have come to our attention during the past several years, but will, we hope, serve to give an idea of the influence of the war upon the character of drug importations, and also an idea as to the nature of the work involved in the supervision of crude drug importations.

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[31] Viehoever and Mastin, "On *Piper bredemeyeri Jacq.* and its Value as a Source for Matico" (unpublished manuscript).

[32] Ewing and Clevenger, "*Eupatorium glutinosum* L. an Adulterant of True Matico (*Piper angustifolium* Ruiz et Pavon)," THIS JOURNAL, 7, 510–12, 1918.

[33] Identified by C. J. Zufall.

[34] Some of the substitutes to which we referred have within recent months been subject to further study:

Chamomile: Ballard, "Wild Anthemis—A Possible Matricaria Adulterant," THIS JOURNAL, 7, 952–54, 1918.

Couchgrass: Gathercoal, "Couch Grass *versus* Bermuda Grass," THIS JOURNAL, 8, 26–32, 1919.

Horehound: Youngken, "*Ballota hirsuta*, A Recent Adulterant of *Marrubium vulgare*," *Am. Journ. Pharm.*, 90, 147–56, 1919.

Jalap: Farwell, "Brazilian Jalap and Some Allied Drugs," THIS JOURNAL, 7, 852–55, 1918.

Marjoram: Beringer, "*Coriaria myrtifolia* as an Adulterant of Marjoram," *Am. Journ. Pharm.*, 90, 555–65, 1918.

Scammony: Scoville, "Scammony and Its Substitutes," *Journ. Ind. Eng. Chem.*, 11, 335–336, 1919.

Stramonium: Guérin, "Substitution of *Xanthium macrocapum*—for Stramonium Leaves," *Jour. pharm. chim.*, (7 ser.), 7, 102–5, 1919.