

Chemical Analyses of the Ingredients of an 1850s Thomson's Compound Syrup of Tar Patent Medicine Bottle

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ABSTRACT

Chemical analyses were undertaken on the contents of a Thomson's Compound Syrup of Tar and Wood Naphtha patent medicine bottle recovered during the archaeological excavation of a ca. 1850s house cellar at the Burning Sands archaeological site in Meredosia, Illinois. Chemical analysis included measurements of 11 metals, measurements of target polyaromatic hydrocarbons, general scans by gas chromatography mass spectrometry (GCMS), and screening for four currently illicit drugs of abuse by high resolution GCMS. In addition to documenting numerous compounds associated with tar, the presence of cannabis was also detected. While many of the chemical compounds identified have antiseptic, analgesic, anti-inflammatory, and antitussive properties, long-term and repeated exposure to some of the potion's ingredients may have resulted in deleterious consequences.

Introduction

In 2014, during an archaeological investigation within the town of Meredosia, Illinois, the Illinois State Archaeological Survey excavated a rectangular, 1.6-m deep, house cellar at the Burning Sands site (11MG491) (Figure 1). This feature yielded a large quantity of 1840s and 1850s domestic artifacts that included an intact, unsealed glass patent medicine bottle embossed on multiple panels with the lettering "THOMSON'S/COMPOUND SYRUP OF TAR/FOR CONSUMPTION/PHILAD" (Figure 2) recovered near the cellar's base. Within this bottle was a quantity of a viscous, dark black, odoriferous, tar-like substance (Figure 3). The bottle was likely discarded during cellar infilling, which occurred sometime during the 1850s.

Medicine bottles from the mid-1800s have been described in many archaeological and historical reports, but the contents themselves are rarely preserved and have not typically been subjected to modern-day chemical testing. Some of the more recent chemical analyses

on late 1800s to early 1900s patent medicine ingredients include Torbenson et al. (2000), Spinner et al. (2011), Diefenbach et al. (2014), Maurice et al. (2015), and von Wandruszka et al. (2015). The recovery of the Thomson's Compound bottle with its intact contents from a secure archaeological context provides a unique opportunity to investigate what served as "medicine" during the 1840s and 1850s.

Six chemical analyses were conducted on the Thomson's Compound bottle contents: 1) inductively coupled plasma mass spectrometry (ICP-MS) used to detect metals such as manganese, copper, zinc, lead, nickel, silver, cadmium, arsenic, and selenium; 2) atomic absorption spectrometry (AA) to detect iron; 3) headspace gas chromatography mass spectrometry (GCMS) used to detect the presence of alcohols such as ethanol and methanol (wood naphtha); 4) GCMS scanning of volatile-semivolatile organic constituents and other ingredients such as "vegetable pectorals;" 5) GCMS analysis of polyaromatic hydrocarbons (PAHs) associated with tar; and 6) high resolution GCMS screening for currently illicit drugs such as cannabis, cocaine, morphine, and heroin. These analyses can determine if the bottle had been reused as a container for materials that differ from its embossed lettering (von Wandruszka et al. 2015), whether the contents are consistent with the few reported ingredients used in the compound's manufacture, and whether unspecified "vegetable pectorals" and other ingredients can be identified.

Thomson's Compound

Thomson's Compound Syrup of Tar and Wood Naphtha was introduced in the fall of 1843 (*Daily Richmond Enquirer* 1845) by druggist Samuel P. Thomson of Philadelphia (not to be confused with New Hampshire-born Samuel Thomson, the herbalist who developed the "Thomsonian" system of alternative medicine in the early 19th century [Young 1961:44–57]). The Philadelphia city directories list Thomson as having a business at the corner of 5th

CHEMICAL ANALYSES OF THE INGREDIENTS OF AN 1850S THOMSON'S COMPOUND SYRUP OF TAR PATENT MEDICINE BOTTLE

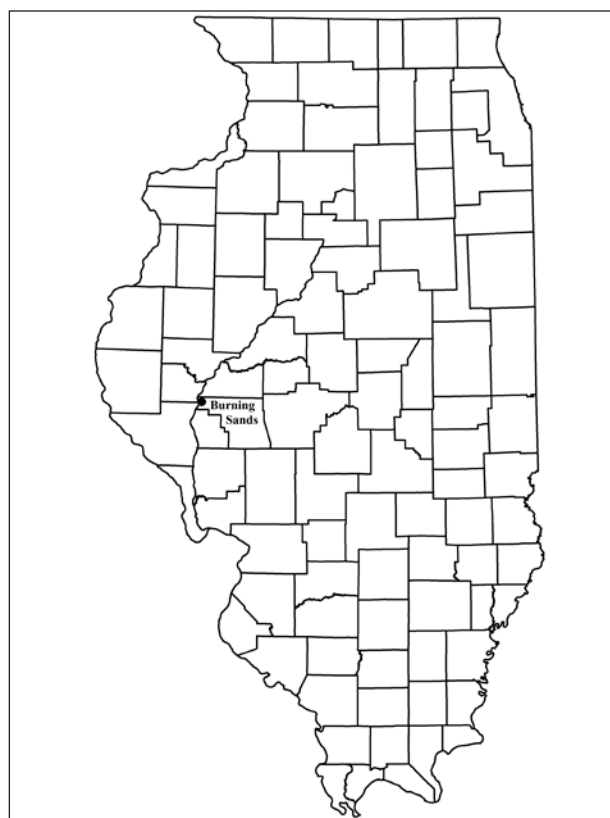


Figure 1. Location of the Burning Sands site in Illinois. (Map by Jennifer Edwards, 2016.)



Figure 2. Thomson's Compound Syrup of Tar and Wood Naphtha patent medicine bottle recovered from Burning Sands. (Photo by Alexis Volner, 2015.)



Figure 3. Contents of Thomson's Compound Syrup of Tar and Wood Naphtha patent medicine bottle. (Photo by Jim Dexter, 2016.)

and Spruce Streets in Philadelphia from 1841 until 1846 (McElroy 1841, 1846); numerous newspaper advertisements of that time state that the office of Thomson's Compound is likewise the northeast corner of 5th and Spruce. Thomson died in 1846 (Maisch 1873), after which the building was occupied by Dr. John R. Angney and druggist John Dickson. Angney and Dickson are subsequently listed as the sole preparers (and occasionally as the "successors of S.P. Thomson") of the elixir at 5th and Spruce in numerous newspaper advertisements in November and December 1846 through June 1850. Dickson apparently left the 5th and Spruce location ca. 1851 (McElroy 1851, 1852), but Dr. Angney remained in business at 5th and Spruce until his death in 1895 (Weicker 1895:436) and was still selling the compound as late as January 1860 (*Public Ledger* 1860).

A September 1848 national advertisement in a South Carolina newspaper touts Thomson's Compound as "[t]he only CERTAIN REMEDY for the Cure of Consumption, Asthma, Bronchitis, Spitting of Blood, Pain in the Side and Breast, sore Throat, Hoarseness, Palpitation of the Heart, Whooping Cough, Croup, Hives, Nervous Tremours, Liver Somplaint, Diseased Kidneys, and Affections generally of the Throat, Breast and Lungs" (capitalization and spellings in original) (*The Camden Journal* 1848). A Baltimore newspaper advertisement from the previous year further states that the ingredients consist of "a union of the principles of some of our most valuable *vegetable pectorals* in a combination of TAR" (italics and capitalization in original) (*The Sun* 1847), while a New Jersey advertisement boasts that "the healing power of Tar" and "some of the most certain Tonic Vegetable Pectorials . . . unite to make it the most valuable medicine ever offered to the public" (spelling and capitalization in original) (*State Gazette* 1848). Exactly what these "vegetable pectorals/pectorals" (i.e., vegetable medicine for the chest and lungs) are within Thomson's Compound is never specified, but many patent medicine advertisements of the 1800s used the word "vegetable" as an homage to the "back to nature" or "all natural" (and therefore originating from God) enthusiasm that was prevalent in home remedies across the nation at that time (Young 1961; Armstrong and Armstrong 1991; Bingham 1994).

Tar has long been used as a medicine and cure for a plethora of maladies, and one of the leading proponents of its use in the 1700s was Irish clergyman and philosopher

George Berkeley who wrote a nearly 200-page treatise on the history and healing properties of "tar-water," claiming the substance cures everything from smallpox to indigestion, and suggesting it may even be useful as a remedy for the plague (Berkeley 1744; see also Johnson 1636; Colden 1745; James 1747). The use of tar-water underwent resurgence in Victorian England and as late as the 1880s was still a recommended treatment for consumption, with the suggested dose being 1–2 pints daily (Yeo 1882:117–118); tar was still marketed as a cure for coughs well into the 1900s and even today is used in some soaps and shampoos for its presumed antiseptic qualities.

The expansion and proliferation of newspapers that followed the westward extension of the frontier in the early 1800s helped promote patent medicines throughout the fledgling United States (Young 1961; Bingham 1994), and Thomson, and later Angney and Dickson, appear to have profusely advertised the mixture soon after its development. To trace the history of the compound's advertising in newspapers, which in turn should give an estimate on the time frame the syrup was available, the Library of Congress "Chronicling America: Historic American Newspapers" (Library of Congress 2015), the Archive of Americana historical newspapers (America's Historical Newspapers 2015), and the Newspapers.com (Newspapers.com 2016) databases, among others, were searched.

The first newspaper advertisement for Thomson's potion that was found occurs in the *Public Ledger* of Philadelphia in early December 1843 (*Public Ledger* 1843). After that date, the compound was heavily advertised in numerous newspapers in the Northeast, along the Atlantic Coast, and in parts of the Southeast and Midwest during the mid- and late 1840s. Even at this time, Thomson's name was occasionally misspelled as "Thompson," and some newspapers (*The Republican Compiler* 1848) even spelled the name differently within the same advertisement. After ca. 1850, when the national company advertisements appear to end, the name was almost always misspelled as "Thompson."

The first Midwestern newspaper that was found advertising the product is the *Southport Telegraph* of Wisconsin in November 1845 (*Southport Telegraph* 1845); after that date advertisements occur in numerous states throughout the upper Midwest. Sometime in 1850 it appears that the national advertising campaign of Thomson's Compound end-

ed and advertising was relegated to local druggists (Prior 1851; *The Daily Dispatch* 1853, 1861; *Public Ledger* 1860). During the 1850s, therefore, there is a dramatic decrease in advertising for the product compared to the late 1840s, and newspaper advertising of Thomson's Compound seems to have come to an end ca. 1861.

Chemical Analyses

The Illinois Sustainable Technology Center completed chemical analysis of the medicine bottle contents. This unknown material consisted of a black viscous tar-like substance with a camphor-like odor. Chemical analysis of the bottle contents included measurements of 11 metals, measurement of PAHs, general scans by GCMS, and screening for four currently illicit drugs of abuse by high resolution GCMS. Results of the chemical analyses are presented below; a more detailed methodology is presented elsewhere (Scott 2015).

Metals Analysis

The medicine bottle contents were subsampled in triplicate and microwave digested into solution by United States Environmental Protection Agency (U.S. EPA) Method 3051A (U.S. EPA 2007a). Chromium, manganese, nickel, copper, zinc, arsenic, selenium, silver, cadmium, and lead measurements were performed with a VG Elemental PQ Excel ICP-MS per U.S. EPA Method 6020A (U.S. EPA

1998). Iron measurements were performed with a Varian Spectra AA 55B atomic absorption instrument per U.S. EPA Method 7000B (U.S. EPA 2007b). Both instruments were calibrated with reference materials and internal standards were used during ICP-MS analysis. In addition, a duplicate sample and an analytical sample spike were performed during both assays as quality control parameters. The results of the reagent blank indicate no contamination was introduced during sample preparations.

Analysis identified several metals that exceed U.S. EPA allowable levels for drinking water (Table 1). While not indicated in the contents of Thomson's Compound, many of the identified metals are found in mineral waters and were used in vegetable tonics and medicines of the period (Dunglison 1856). Many metals, particularly when oxidized or acidified, have diuretic or purgative effects (e.g., magnesium, iron), and act as antispasmodics (e.g., copper, zinc) (Dunglison 1856).

PAH Analysis

PAHs are chemicals that are often associated with tars, coals, crude oils, and combustion by-products. They can exist in over 100 different combinations and are categorized and ranked by the U.S. EPA according to their toxicity.

A 50 mg subsample of the medicine bottle contents was dissolved in 20 ml hexane for PAH analysis. The GCMS analysis targeted 16 U.S. EPA Priority Pollutant PAHs, 2

Table 1. Metals Results for Medicine Bottle Contents and U.S. EPA Minimal Allowable Limits.

	Chromium ^a	Manganese ^b	Nickel ^c	Copper ^a	Zinc ^b	Arsenic ^a	Selenium ^a	Silver ^b	Cadmium ^a	Lead ^a	Iron ^b
Average Medicine Bottle $\mu\text{g/g}$ or ppm	5.9	147	3.3	1.9	14	1.1	<2.0	<0.5	0.088	20	3800
STDEV (of 3)	1.3	32	0.19	0.72	1.9	0.042	Not Calculated	Not Calculated	0.014	2.1	173
Maximum Contaminant Level Goal (U.S. EPA)											
Minimum Allowable ^a	0.1	0.05	Not Established	1.3	5	0	0.05	0.1	0.005	0	0.3

^aU.S. EPA 2015a

^bU.S. EPA 2015b

^cH₂O Distributors 2015

methyl substituted naphthalenes, and 5 dimethyl substituted naphthalene isomers. These are of interest because of their known toxic or carcinogen effects. PAH analysis was performed per U.S. EPA Method 8270C, with modifications to include methylated naphthalenes (U.S. EPA 1996). The instrument utilized for analysis was a Thermo Scientific Trace 1300 GC coupled to an ITQ700 ion trap mass spectrometer. All 16 PAHs targeted were identified within our sample as well as the seven methylated naphthalenes (Table 2). Although these results are quantitative, providing information on compounds that are present in the substance, the original quantities and proportions cannot be determined due to different levels of volatility.

Table 2. Final PAH Results for Medicine Bottle Contents^a.

Compound Group	Medicine Bottle µg/g	Medicine Bottle Analytical Spike, % Recovery
Naphthalene ^b	15	105%
2-Methylnaphthalene	27	108%
1-Methylnaphthalene	30	107%
2,6-Dimethylnaphthalene	25	110%
1,3-Dimethylnaphthalene	33	109%
1,4-Dimethylnaphthalene	30	85%
1,2-Dimethylnaphthalene	35	98%
1,8-Dimethylnaphthalene	12	108%
Acenaphthylene ^b	29	93%
Acenaphthene ^b	22	90%
Fluorene ^b	56	116%
Phenanthrene ^b	160	109%
Anthracene ^b	330	97%
Fluoranthene ^b	605	98%
Pyrene ^b	150	111%
Benzene (a) anthracene ^b	310	93%
Chrysene ^b	220	113%
Benzo (b) fluoranthene ^b	98	119%
Benzo (k) fluoranthene ^b	120	107%
Benzo (a) pyrene ^b	110	103%
Indeno (1,2,3,c,d) perylene ^b	65	113%
Dibenz (a,h) anthracene	76	108%
Benzo (g,h,i) perylene ^b	65	107%

^a 50 mg sample dissolved in 20 ml hexane. Analysis by GCMS in SIM mode.

^b U.S. EPA Priority Pollutant.

Therefore, the PAH concentrations measured in this sample represent the minimum amounts of these compounds in the original sample. Many of these are associated with tar, wood naphtha (wood alcohol), and their derivatives.

The alcohols associated with wood naphtha would not only act as a solvent for many of the essential oils, but in high enough doses would have an intoxicating effect. Many of the compounds have anesthetic, antibacterial, or antiseptic properties (e.g., fluorine, phenols) (Dunlison 1856). Naphthalene derivatives have anti-inflammatory properties (Huang et al. 2003), while many of the phenols are used in medicinal preparations such as mouthwash and sore throat lozenges, likely because of their antiseptic and anesthetic properties (Sadler et al. 1918). Benzene and related compounds also are used to dissolve other substances (Sadler et al. 1918). Phenanthrene (and its linear isomer, anthracene) is highly soluble in benzene and other organic solvents. It is the backbone of morphinan, which is a structural component of a number of psychoactive chemicals, including opiate analgesics, cough suppressants (antitussives), and dissociative hallucinogens (e.g., codeine, morphine, etc.) (Thorpe 1890; Sadler et al. 1918). Chrysene is a PAH found in creosote, a substance long used in the treatment of colds and bronchial conditions, including acute and chronic bronchitis, and tuberculosis. Creosote has expectorant, antiseptic, and anesthetic properties (quaifenesin is a synthetic creosote).

GCMS General Scans

General scans by GCMS were performed and provided qualitative information with regards to the major components present in the sample. These were done both on an aliquot dissolved in hexane and in headspace mode. Headspace GCMS analysis involves heating the sample to a relatively high temperature, 80°C, for 30 minutes with constant agitation. After 30 minutes, 0.5 ml of the headspace above the sample is collected and injected into the GCMS instrument. The goal of this method is to facilitate volatilization of low boiling compounds present in the sample and was performed to provide a better understanding of the compounds responsible for the odoriferous nature of the sample. Mass spectra of the main peaks found in the resulting chromatograms were compared to a library of mass spectra data of known compounds. The identification

of major components is based on the best possible match in the mass spectral database. The identification results are limited to compounds available in the database and would need to be compared to reference materials for further verification. Table 3 presents the results from the GCMS general scans performed in this study.

Most of the compounds identified in the GCMS general scans are associated with the essential oils of coniferous

trees (e.g., terpinene, pinene, camphene) and other plants, such as oregano, thyme, and eucalyptus (e.g., pinene, cymene). These were used in expectorants for the treatment of bronchial conditions, often in combination with antitussives such as codeine (Dunglison 1856; Thorpe 1890; Sadtler et al. 1918). They also have a weak antiseptic effect on pulmonary tissues. In addition, camphor-like compounds, such as camphene and α -campholenal, were

Table 3. GCMS General Scan Results for Medicine Bottle Contents.

Scan 1, Hexane Aliquot: Compound	Probability, %
1-Phenanthrenecarboxaldehyde, 1,2,3,4,4a,9,10,10a-octahydro-1,4a-dimethyl-7-(1-methylethyl)	61.3
4b,8-Dimethyl-2-isopropylphenanthrene, 4b,5,6,7,8,8a,9,10-octahydro	47.2
Phenanthrene, 2,5-dimethyl-	76.6
10,18-Bisnorabieta-5,7,9(10),11,13-pentaene	63.6
9-Ethyl-10-methylanthracene	70.9
Retene	89.5
8-Isopropyl-1,3-dimethylphenanthrene	95.5
Methyl dehydroabietate	90.5
Scan 2, Headspace with Non-Polar GC Column: Compound	Probability, %
3-Carene	82.1
α -Pinene	86.9
Camphene	79.1
1,4-Cyclohexadiene, 3,3,6,6-tetramethyl-	69.5
α -Terpinene	86.2
o-Cymene	92.1
γ -Terpinene	84.2
o-Isopropenyltoluene	51.7
Benzene, 1-ethyl-4-(1-methylethyl)-	64.2
Santolina triene	85.1
Benzene, 1-ethyl-4-methoxy-	70.5
α -Campholenal	90.1
Santolina epoxide	82.2
Estragole	88.9
Scan 2, Headspace with Polar GC Column: Compound	Probability, %
1,3-Cyclohexadiene, 1,3,5,5-tetramethyl-	79.8
α -Pinene	93.7
γ -Terpinene	91.3
Santolina triene	88.2
Camphene	77.5
o-Cymene	76.5
m-Cymene	88.2
Benzene, (1-methylethyl)-	88.3
α -Campholenal	95.5

also detected and are most likely responsible for the odoriferous nature of the sample.

High Resolution (GCMS) Screening for Currently Illicit Drugs

Screening for currently illicit drugs was performed using an Autospec Ultima High Resolution Mass Spectrometer coupled to an Agilent 6890 GC. Operation of the mass spectrometer in this mode allows accurate mass measurements to 0.0001 atomic mass units or less and allows identification of the chemical formula from compounds eluting from the GC column. An aliquot of the medicine bottle sample dissolved in hexane was utilized for high resolution GCMS screening of currently illicit drugs. The drugs screened by this method included morphine, cocaine, Δ^9 -tetrahydrocannabinol (cannabis), and heroin. No instrument response was observed for morphine, cocaine, or heroin; however, an intense peak was detected for the accurate mass associated with Δ^9 -tetrahydrocannabinol (Figure 4). Figure 5 presents the mass spectrum of Δ^9 -tetrahydrocannabinol. An intense fragment at 299.2011 atomic mass units (amu) should also be observed in the mass spectrum for a peak responsible for this compound. Therefore, a second high-resolution experiment set to

collect two accurate masses specifically associated with Δ^9 -tetrahydrocannabinol was performed. The accurate masses measured were 314.2246 amu (the molecular ion) and 299.2011 (the base peak). Figure 6 presents the high-resolution GCMS chromatogram obtained from this experiment. These data show that both the molecular ion and base peak ion are responsible for the peak suspected to be a result of the presence of Δ^9 -tetrahydrocannabinol in the medicine bottle contents. To determine the concentration of Δ^9 -tetrahydrocannabinol would require comparison to a standard of this controlled substance, which is not feasible for this study.

Summary

These results provide information on the composition of the bottle contents, but with the exception of metals and PAHs are not able to provide accurate quantities or proportions of components. Since the bottle was not sealed, evaporation of volatile compounds (e.g., alcohols) and degradation of other materials likely occurred at levels that cannot be determined. With the notable exception of cannabis, the results are consistent with the expected components of a remedy advertised as primarily containing tar. Many of the ingredients identified would have had palliative

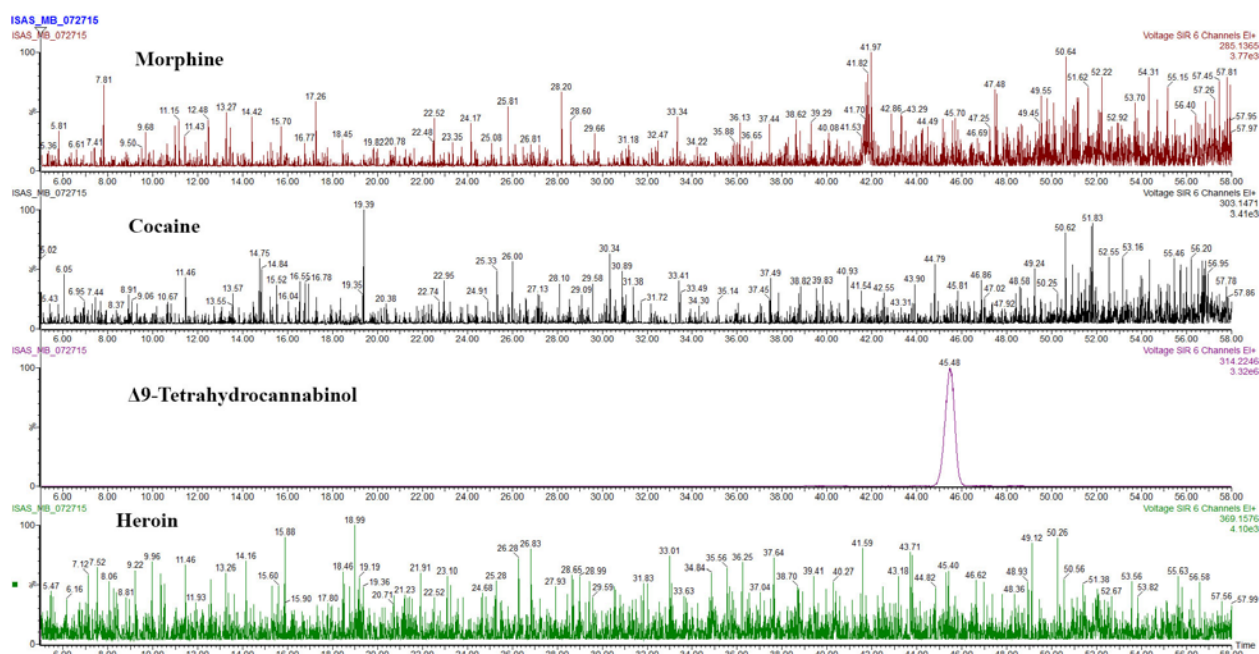


Figure 4. High resolution GCMS screening of illicit drugs in the medicine bottle contents. (Graphic by John Scott, 2015.)

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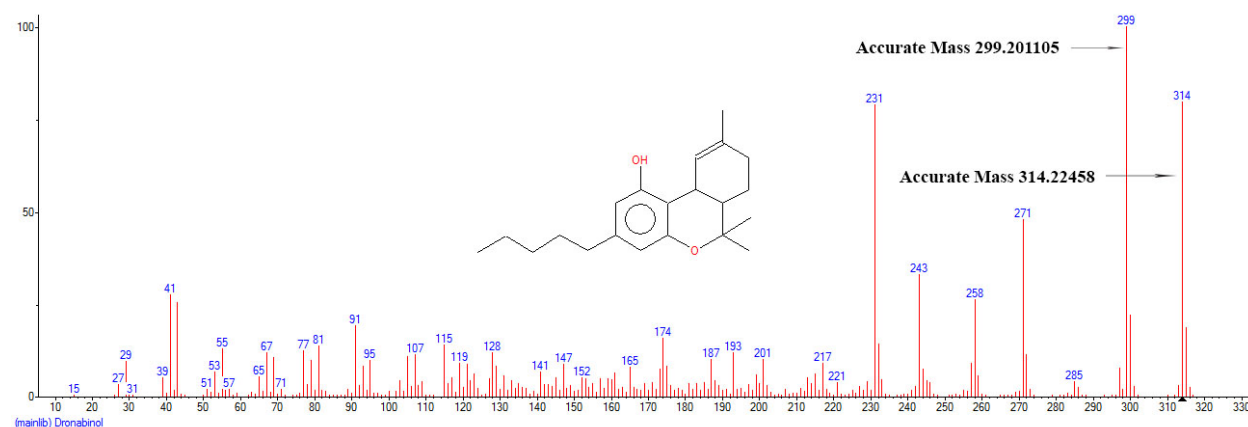


Figure 5. Mass spectrum of Δ^9 -tetrahydrocannabinol. (Graphic by John Scott, 2015.)

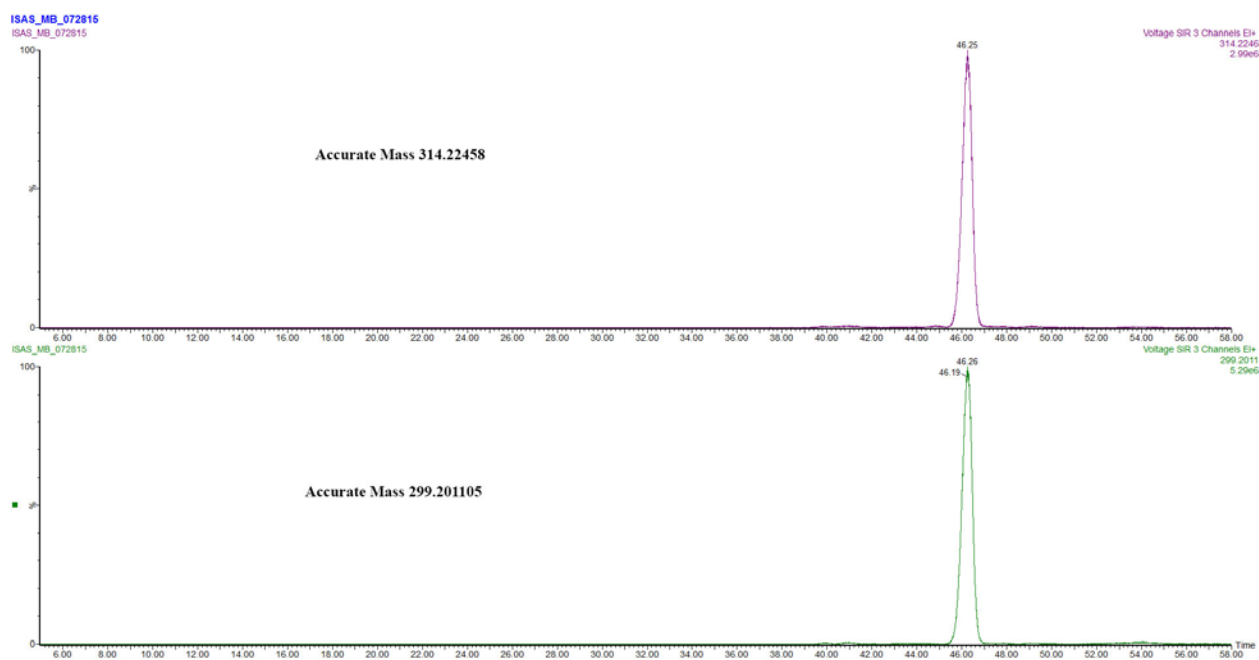


Figure 6. High resolution GCMS screening of Δ^9 -tetrahydrocannabinol in the medicine bottle contents. (Graphic by John Scott, 2015.)

effects for coughs, colds, and other bronchial conditions by providing pain relief, lowering fever, relieving congestion, and calming coughs. The narcotic effects of alcohol and cannabis may well have helped with nervous tremors, heart palpitations, and other nervous conditions, as well as aiding in sleep. Long-term and repeated exposure, however, to several metals present within the compound could have resulted in serious health effects.

Numerous medicines of the late 1800s and early 1900s contained morphine, heroin, or cocaine as a pain-relieving

ingredient (Kebler 1910; American Medical Association 1911; Maurice et al. 2015), and many potions (Adams 1907:50, 157; Kebler 1910:5, 13; Sasman 1938; Sullivan 2007; Antique Cannabis Book 2014) contained cannabis. One of the earliest 19th-century proponents for the use of cannabis as a pain reliever and a “powerful sedative” was Dr. W.B. O’Shaughnessy who published an article extolling the virtues of *Cannabis indica* in a British medical journal in February 1843 (O’Shaughnessy 1843). Samuel Thomson, who developed Thomson’s Compound at the end of that

year, may have been among the first in the United States to mass-produce a pain reliever containing cannabis; it is also possible that Angney and Dickson added cannabis to the mixture when they began preparing it after Thomson's death in 1846. Regardless of their claim that it was a consumption cure, Thomson's Compound Syrup of Tar and Wood Naphtha probably worked well as a cough and cold remedy, pain reliever, and sleep aid, but repeated ingestion may have had deleterious consequences over the long term.

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