Oil of Turpentine: Sheet Anchor of 19th-Century Therapeutics

by

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Abstract

Oil of turpentine is an essential oil extracted and distilled from the gum resin of several species of pine trees. It was used by laypeople for relief from blisters, burns, corns, lumbago, sciatica, sore gums, abscessed teeth and insect bites. Physicians, on the other hand, employed oil of turpentine to treat some of the major diseases of the nineteenth century. It was an effective, orally administered therapeutic agent against intestinal disorders such as typhoid fever and worms (esp. tapeworms), and somewhat effective topically against hospital gangrene, and myiasis. By the beginning of the 20th century, however, oil of turpentine had lost its preeminent place in the therapeutic armamentarium, having been supplanted by safer and more effective drugs. Today, oil of turpentine has no medicinal uses, except as an inactive ingredient in over-the-counter topical ointments.

Keywords: Oil of turpentine, typhoid fever, worms, hospital gangrene, myiasis, malaria

Not unlike today's patients, their nineteenth-century counterparts expected to be prescribed medicine when they presented with an illness. A physician could not simply genuflect before the precept *vis medicatrix naturae* (the healing power of nature) and do nothing. He had to be a man of action; in short, a therapeutic interventionist. '[A]ctive therapeutic intervention in an effort to redeem patients from disease, was at the core of what it meant to be a physician in America.'[1]

Nineteenth-century orthodox practitioners had relatively little to offer in the way of effective drugs; viz., quinine and morphine. With few exceptions, there were no cures. Worried that more harm than good was done by dangerous medications of unproven value, Boston sage Oliver Wendell Holmes (1809-1894) wrote: 'I firmly believe that if the whole materia medica, *as now used*, could be sunk to the bottom of the sea, it would be all the better for mankind, -- and all the worse for the fishes.'[2] In truth, many substances now recognized as poisonous were commonly prescribed, notably calomel (mercurous chloride) and turpentine. Although there is an extensive literature on mercurials, turpentine has not received the serious attention from medical historians that it deserves. This article intends to rectify this situation.

Oil of Turpentine

Oil of turpentine (oleum terebinthinae), or spirits of turpentine, is a volatile oil extracted and distilled from the gum resin of the longleaf pine tree, *Pinus palustris*, and the loblolly pine, *P. taeda*, both of which are indigenous to the southeastern United States. In the 19th century, vast conifer forests covered nearly 150,000 square miles, stretching from southeastern Virginia to the Florida peninsula to southeastern Texas.[3] Turpentine harvesters debarked live trees – a process called "boxing" -- and collected the sticky resin that ran down over the wound surface. (This is the tree's natural defensive response to protect itself against insect invasion.) Distillation of the crude resin yields three products: turpentine, an essential oil called oil of turpentine, and rosin.[4] *P. palustris* resin yields about 17% oil of turpentine.[5] The best oil for medicinal purposes had a specific gravity of 0.860-0.870, and was distilled between 155-180 ^{0}C without leaving a residue.[6]

Pure oil of turpentine is a clear, colorless liquid with a pungent odor and a bitter taste. It is slightly soluble in water, less so in alcohol, but readily soluble in ether.[7] High doses (>3 fluid oz.) are toxic and cause mental confusion, nausea, and vomiting.[8] The oil imparts a characteristic turpentine odor to the breath, and a fragrance of violets to the urine.[9] Modern research has disclosed that the flowery scent is due to two metabolites of turpentine, ionone and its ring methylated derivative, irone, both of which are eliminated in the urine.[10]

By the end of the 15th century, the association between turpentine and the violet scent of urine was solidly established. In May 1780, Benjamin Franklin (1706-1790) proposed a facetious prize problem to the Royal Academy of Brussels: ‘To discover some Drug wholesome & not disagreeable to be mixed with our common Food, or Sauces, that shall render the natural Discharges of Wind from our bodies, not only inoffensive, but agreeable as Perfumes.’ Franklin reasoned, ‘A Pill of Turpentine no bigger than a Pea, shall bestow on [our urine] the pleasing Smell of Violets. And why should it be thought more impossible in Nature, to find Means of making a Perfume of our Wind than of our Water.’[11]

Based on anecdotal evidence, laypeople applied oil of turpentine externally for relief of a myriad of medical conditions: blisters, burns, corns, lumbago, sciatica, sore gums, abscessed teeth, and insect bites. Orthodox physicians, on the other hand, tested the oil clinically for its therapeutic properties against several major diseases of the nineteenth century. Oil of turpentine, administered orally, was clearly effective against intestinal disorders, especially typhoid fever and worms; somewhat effective topically against hospital gangrene and myiasis; and simply useless for the treatment of malaria.

Typhoid Fever

Typhoid fever, endemic in 19th–century America, was a major killer of U.S. soldiers during the Civil War (1861-1865) and *the* major killer during the Spanish-American War (1898). It is a contagious disease characterized by prolonged fever, diarrhea, abdominal pain, skin rash (rose-colored spots), prostration and, toward the end, delirium. Its etiologic agent is a rod-shaped bacterium *Salmonella typhi*. Intestinal discharges of individuals with typhoid constituted the principal source of typhoid bacilli. Next to human contact (feces-contaminated hands, clothing, etc.) the nonbiting house fly, *Musca domestica*, was the chief means of disseminating the disease. Synanthropic (affinity for man) flies were mechanical vectors, unwittingly carrying infective matter from the latrine to the camp kitchens, mess halls, and hospital wards on their sponging mouthparts, exoskeletal hairs and bristles, and pulvilli.[12] 'Ingenuity could not devise any plan so simple, so efficacious, and so widespread for scattering pestilence as this.'[13]

The medical literature of the day abounded with so many synonyms for typhoid that the addled researcher could never be quite sure of the disease in question. Among its myriad names, typhoid fever had been designated enteric fever, typhus mitior, abdominal typhus, low fever, endemic fever, common continued fever, bilious fever, night-soil fever and pythogenic (filth) fever.[14]

In 1826 George Bacon Wood (1797-1879), a physician and professor of chemistry at the Philadelphia College of Pharmacy, pioneered the oral use of oil of turpentine in the treatment of patients diagnosed with typhus mitior, or typhoid fever. 'I prescribed the spirits of turpentine,' Wood wrote, ‘in the form of julap [or julep, a sweet aqueous solution] in the usual dose of ten or fifteen drops, frequently repeated. The case in which it was given, I had considered almost hopeless; but twenty-four hours had not elapsed before a decided change for the better had occurred, and in a few days the patient was convalescent.’[15]

Three decades later, in his *Treatise on Therapeutics and Pharmacology or Materia Medica*, Wood divulged how he arrived at this discovery. At autopsy he had found ulcers in the ileum of typhoid patients. ‘Therebinthinate remedies having been found useful in ulcerative affections of the bowels,’ he noted, ‘it occurred to me that the oil of turpentine might possibly answer my purpose in this instance.’[16] Wood, at the time, believed intestinal ulcers were common in all fevers. However, through the work of the celebrated Paris clinician, Pierre Charles Alexandre Louis (1787-1872), proselytizer of the *méthode numérique*, Wood learned that the small bowel lesions he had observed were located in Peyer’s patches, aggregates of lymph nodes, and were, in fact, pathognomonic of typhoid fever. ‘Ever since that time,’ Wood wrote, ‘I have been in the habit ... of strenuously recommending the oil of turpentine in the treatment of enteric or typhoid fever.’[17]

In 1829 Louis named the continued fever then raging in Paris *la fièvre typhoïd*, because of its resemblance to typhus. He observed that Peyer’s patches – difficult to find in the healthy intestine – were invariably reddened and swollen in the ileum of those dead from typhoid. Further, the number of ulcerated patches correlated with the severity of the disease. These lesions, Louis wrote, were not merely peculiar to typhoid, but form ‘their anatomical characteristic as much as tubercles do to that of phthisis.’[18]

Wood observed that ulcers in Peyer’s patches appeared at the end of the second week in the natural course of the disease, and were heralded outwardly by the patient’s tongue becoming dry and glazed. This was the signal for commencing turpentine treatment. 'Previously to my original use of the oil, I had seen a majority of the cases that came under my notice prove fatal; and, since the use of it only two.'[19] As the patient's health improved the tongue became moister and covered with a whitish fur resembling thrush.[20]

In his widely popular *Treatise on the Practice of Medicine,* Wood extolled the virtues of oil of turpentine in cases of typhoid fever. Even Wood's therapeutic failures pointed to the healing nature of oil of turpentine. For example, he performed an autopsy on a patient who had been doing well under oil of turpentine therapy, but suddenly, in the space of six to seven hours, died from peritonitis. 'Examination showed the ulcerated glands of Peyer in a healing state; but ... a small ulcer ... had perforated the coats of the bowel, and allowed the escape of its contents. The oil of turpentine had not been able to reach this ulcer at the bottom of a cul-de-sac, filled as it was with mucus, and consequently had not exercised the same curative influence upon it, as had been produced in the accessible ulcerations of the general mucus surface.'[21] Wood also noted that in advanced stages of typhoid when intestinal gases were voluminous and painful, enemas of oil of turpentine gave welcome relief.[22]

In 1850, western physician Daniel Drake (1785-1852) published the first volume (topography of disease) of his classic *Diseases of the Interior Valley of North America*, and the second volume (specific febrile diseases) appeared posthumously in 1854. Drake's treatise is an unparalleled source of information on human diseases and their treatment in the United States during the first half of the nineteenth century.

Defining his position on the medicinal use of oil of turpentine for the treatment of typhoid fever, Drake wrote:

'Oil of turpentine … has long been employed in [typhoid fever], and its use in the Interior Valley is universal…. It is regarded as exerting its influence chiefly on … arresting the progress of glandular lesions in the ileum … and, above all, exciting those peristaltic actions which effect the expulsion of flatus, and avert or remove typanitis…. On the whole, it may be regarded as one of our valuable therapeutic agents in the advanced stages of abdominal typhus [typhoid fever]. It may be administered in doses of twenty, forty, or sixty drops, every two to four hours, in a spoonful of wine, or absorbed on finely pulverized sugar.'[23]

Charles Beneulyn Johnson (1843-1928), a hospital steward with the 130th Illinois Volunteer Infantry, wrote in his post-Civil War memoirs, *Muskets and Medicine* (1917): 'In that era most medical men regarded turpentine as little short of a sheet-anchor in the treatment of typhoid.... It was a standard remedy in our regimental hospital.'[24] The core function of a hospital steward was to serve as a pharmacist, with responsibility for compounding medicines. Johnson's turpentine prescription (Table 1) was widely accepted as a specific for healing the intestinal ulcers characteristic of typhoid. Indeed, the Union army supply table for general hospitals listed two 32-ounce bottles of oil of turpentine per 100 beds. Its uses were described as 'Given internally as an anthelmintic ... and in low fevers (especially typhoid).'[25]

As with all human endeavors, there were naysayers who challenged the efficacy of turpentine against typhoid. Among them was Union army surgeon, Joseph Janvier Woodward (1833-1884). In this case, he was not a crackpot spouting off, but an outstanding member of the medical profession. Woodward, author of the colossal volume on the alvine fluxes (diarrhea and dysentery) in *The Medical and Surgical History of the War of the Rebellion* (1879), claimed that oil of turpentine was not as effective as he had expected. In his experience, treatment with the essential oil frequently aggravated the diarrhea, and did not exert 'any decidedly favorable influence on the progress or degree of any of the abdominal symptoms.'[26] He did however, concur with Daniel Drake and his own mentor George Wood's earlier findings (*supra*) that oil of turpentine diminished tympanites. It is difficult to determine the basis of Woodward's statement, because an examination of his published writings from 1858-1881 failed to uncover any data regarding the use of turpentine in the treatment of typhoid fever. Factors, such as dosage and route of administration, which influence the outcome are nowhere to be found.[27]

Intestinal Worms

Intestinal worms are the oldest recognized parasitic organisms of humankind. Worm infestations were ubiquitous in rural and urban populations, leading Dutch mathematician and inventor of the screw-barrel simple microscope, Nicolaas Hartsoeker (1656-1725) to conclude: 'I believe that the worms cause most of the diseases which attack mankind and even those who have diseases which one calls venereal.'[28] Since worm infestations were known to be highly injurious to health, countless attempts were made over the ensuing centuries to find agents that would kill and expel these creatures.

In 1910 paleopathologist, Sir Marc Armand Ruffer (1859-1917), discovered calcified eggs of the blood fluke *Schistosoma haematobium* in the kidneys of two mummies of the XXth dynasty (1200-1090 BC), proving the existence of bilharziasis, or schistosomiasis, in ancient Egypt. Various roundworms and flatworms recorded in the longest and most complete of all the Egyptian medical papyri, the Ebers Papyrus (1550 BC), have now been identified as *Ascaris lumbricoides*, the large intestinal worm of humans, tapeworms of the genus *Taenia*, and the guinea-worm, *Dracunculus medinensis*, the "fiery serpent" of Mosaic times (Num. 21:6).[29] During their captivity in Egypt, the Israelites were not plagued by actual snakes. Rather, they suffered from an outbreak of dracontiasis. 'Fiery serpents' is an apt description of a worm that can be seen moving beneath the skin, that causes a severe inflammatory reaction in the infected part, and is not infrequently fatal.[30]

Early Greek and Roman authors had a more extensive knowledge of parasites than the Egyptians did, and knew which parts of the intestine were inhabited by which worms. For example, *Ascaris* was found in the upper section of the small intestine, while the pinworm *Enterobius* was found chiefly in the rectum and anus. Tapeworms extended over the entire length of the small intestine.[31]

The ancient Hindus recognized intestinal roundworms, pinworms, and tapeworms. The *Atharvaveda* (c. 1200-1000 BC), the first written reference to medical practice in India, contains numerous magical spells to ward off worm infestations.[32]

Benjamin Rush (1746-1813), Professor of Medicine at the College of Philadelphia (later the University of Pennsylvania), was ahead of his time when he did a series of *in vitro* experiments with earthworms (Annelida). He selected earthworms because they were easy to obtain, and were similar in anatomy, digestive processes, and reproduction to intestinal roundworms (Nematoda). Rush placed live earthworms into solutions of 67 different substances purported to have anthelmintic properties, and recorded their time of death. He observed that oil of turpentine killed earthworms within six minutes, whereas Carolina pink-root, a '*certain* anthelmintic,' took 33 minutes to accomplish the same effect. Rush wisely ended his chapter titled "Worms in the Alimentary Canal" with the caveat that his *in vitro* results may not necessarily translate to *in vivo* anthelmintic activity.[33]

In 1823, a Glasgow physician published case reports of five patients who presented 'with the usual symptoms of alvine irritation ... abdomen tumefied and intolerant of pressure.' All were treated with oral doses of oil of turpentine, typically one fluid ounce in three ounces of sweetened milk, repeated after an interval of four hours or more. After dosing with a purgative powder containing calomel and gamboge, four patients expelled large numbers of roundworms – all dead and smelling strongly of turpentine. The fifth case, a seven-year-old girl, expelled a dead tapeworm measuring four feet in length. Again, the odor of turpentine was prominent. The girl was subsequently given oil-of-turpentine enemas, and expelled a considerable number of proglottids. All patients had their health restored, and experienced no relapses of the disease over a two to eight year follow up. The author concluded: 'Essential oil of turpentine ... may now be regarded as one of the best and most certain means of procuring the expulsion of intestinal worms.'[34]

Because of its detergent and cathartic actions, oil of turpentine, administered orally for small-intestine parasites, or as enemas for large-intestine parasites, was widely considered one of the most reliable anthelmintics known, especially against cestodes (tapeworms).[35] An ounce of oil given in a glass of milk, followed by a purgative dose of castor oil, was recommended for destroying and expelling worms from the intestinal tract.[36] The oil's hegemony was usurped by Koosso, a compound isolated from the fragrant flowers of a small tree, *Brayera anthelmintica*. When administered as a decoction in milk, Koosso was observed to kill tapeworms three-times faster than oil of turpentine.[37] Wood opined: 'Until the introduction of Koosso into use, [oil of turpentine] stood at the very head of the remedies employed against tape-worms.'[38] Koosso was considered so safe that it was the preferred vermifuge for children two to ten years of age.[39]

Hospital Gangrene

During the Civil War, hospital gangrene, or necrotizing fasciitis (flesh-eating disease), was the disease most feared by combatants on both sides, because of the horrifying appearance of a gangrenous wound, and the fact that it was so quickly fatal (mortality rate of 46%).[40] At the height of the infection hopeless misery was reflected in the patients's faces: 'the complexion assumes an unhealthy, dusky, leaden hue, the eyes express anxiety, depression, and nervous irritation and exhaustion.'[41] To control the spread of mortification to surrounding healthy tissue, it was recommended that the wound be debrided and then covered with bandages soaked in oil of turpentine. It was claimed that this remedy was painless, eliminated the intolerable fetor, and arrested the progress of tissue decomposition.[42]

Confederate surgeon Joseph Jones (1833-1896), the South's equivalent in scientific accomplishments to the North's Woodward, recommended that after the dead tissues were removed 'The entire wound is then to be carefully wiped out with a sponge or dry lint, and the concentrated [nitric] acid applied with a brush or mop to the entire surface; and care should be taken that the acid penetrate into all the sinuses and cavities. If any diseased part be untouched or undestroyed by the acid, the disease will recommence and spread from that point.'[43] Subsequent to nitric acid treatment, the wound was routinely washed with water and kept antiseptic by applying oil of turpentine.

Midway through the Civil War, oil of turpentine was superseded by a more efficacious remedy: bromine. Elemental bromine is a corrosive, reddish-brown liquid at room temperature. Union army surgeon Middleton Goldsmith (1818-1888) analyzed mortality data from 334 gangrenous patients, and concluded that bromine, when applied topically to a gangrenous wound, produced a significantly lower mortality rate (2.6%; n=8 of 304) than nitric acid (61.5%; n=8 of 13) and other remedies (38.5%; n=5 of 13).[44] Four patients treated with other remedies after bromine failed were excluded from the statistical analysis. It is instructive that oil of turpentine was not included among Goldsmith's 'other remedies.'[45] Perhaps Goldsmith believed the oil was not sufficiently effective to test against bromine. ‘Bromine will as surely arrest hospital gangrene as quinia will ague.’[46] Goldsmith backed his claims with concrete statistical data, in contrast to the largely anecdotal case reports for oil of turpentine. In other words, Goldsmith drew his conclusions from the analysis of groups of cases, whereas in oil of turpentine publications, generalizations were made based on individual cases. Medical historian Shauna Devine has argued that the use of bromine to treat and prevent gangrene was one of the most significant scientific achievements of the war.[47]

There was a downside to Goldsmith’s medication. Because of its corrosive properties, intense pain often accompanied the use of bromine, such that patients had to be sedated with chloroform, sulfuric ether or morphine prior to the procedure. In one such instant, Act. Assist. Surg. Roberts Bartholow (1831-1904) at the West End U.S. General Hospital in Cincinnati, Ohio substituted oil of turpentine twice daily for bromine with welcome relief. Sloughing was arrested without any attending pain, granulation progressed and the patient, a 25-year-old infantryman, was pronounced ‘nearly well.’[48]

Confederate surgeons preferred treating hospital gangrene with concentrated fuming nitric acid -- the name itself is foreboding. Like bromine, nitric acid was frequently attended with such great suffering that patients had to be sedated. It these cases, it was noted that patients benefited from washing the mineral acid away, and filling the mortified cavity with lint or raw cotton saturated with oil of turpentine. Turpentine prevented the ‘extensive and rapid disorganization’ of sound tissue around the original wound.[49]

The adoption of Listerian antiseptic techniques in the mid-1870s eradicated hospital gangrene from surgical wards worldwide, obviating the need for chemotherapy.[50]

Myiasis

On 3 April 1837, naturalist Frederick William Hope (1797-1862) read a paper before the Entomological Society of London, in which he introduced the term *myasis* (now spelled *myiasis*) to describe infestations with dipterous larvae (maggots). He also proposed the terms *canthariasis* for infestations with coleopterous larvae (grubs), and *scholechiasis* for infestations with lepidopterous larvae (caterpillars).[51] Presently, myiasis is defined as maggot infestations of tissues, wounds and body cavities in *live* humans and vertebrate animals.[52]

The enormous number of dead bodies strewn across Civil War battlefields quickly became infested with maggots. Describing the appearances of corpses at the battle of Spottsylvania Court House (May 1864), a Rebel private noted: “Their faces were nearly black, and their mouths, nose, eyes, hair, and the mutilated parts were full of maggots.’[53] Not only were the bloated, decomposed dead bodies maggoty, but the battle wounds of the hospitalized survivors were also flyblown.

Blow flies (Order: Diptera; Family: Calliphoridae) were the first insects to colonize human and animal (horses and mules) remains on the battlefield. House flies (Order: Diptera; Family: Muscidae), on the other hand, constituted more than 90% of the fly species in the vicinity of military camps and hospitals.[54]

For the purpose of this essay, the most important maggot is the third instar larva of the common house fly, *M. domestica*. It has no eyes, legs, antennae or other appendages. After feeding for three to nine days, the larva undergoes pupation where it metamorphoses into an adult fly. The maggot is vermiform, several millimeters long, creamy white in color, and consists of thirteen segments. Two spiracles and an anus occupy the blunt posterior segment, while the tapered anterior segment houses the mouth. Locomotion of the footless larva is surprisingly rapid, producing a peculiar wriggling motion that proved so annoying to its human hosts.[55]

Legions of house flies plagued military hospital wards where, searching for breeding sites, gravid females oviposited their eggs into soldiers's moist and smelly open wounds (targets of opportunity). Flyblown wounds looked revolting, and the larvae's wriggling tormented semiconscious men who were often too weak to brush them aside. Union army surgeons, in an effort to maintain wound cleanliness, employed oil of turpentine to kill these 'little ravenous maggots.' Since flies deposited their eggs through several layers of muslin, the most effective remedy was to simply change the turpentine-soaked dressing every two to three hours.[56]

The effectiveness of oil of turpentine in myiasis was further tested in laboratory trials. Under army contract, civilian surgeons at Bellevue Hospital in New York City experimented with oil of turpentine as a larvicide, and concluded that the oil destroyed maggots, but only when employed at a strength which might prove hurtful to most raw surfaces. On the other hand, they discovered that an aqueous solution of creosote (also a distillate of pine trees) and chloroform killed maggots in 4-5 minutes, without injuring the tissues treated. There was an unexpected bonus. Attracted to breeding sites principally by odor, flies never deposited their eggs when the pungent odor of creosote permeated the area.[57]

Confederate surgeons attending Union prisoners in Chattanooga, Tennessee were so short of medical supplies that they were compelled to leave many of their patient's wounds un-bandaged and flyblown. To their surprise, they found that the maggots themselves were not harmful, but actually aided healing by eating necrotic tissue. Maggoty wounds healed quickly with minimal scarring, whereas patients whose wounds were denuded of maggots died in larger numbers.[58] The maggots feeding activity not only cleansed the wound of dead tissue and microbes, but shifted the acidic pH of the wound's juices to a beneficial alkaline pH, thus stimulating healthy granulation.[59] This procedure was later called *maggot therapy*, but *biological debridement* seems more accurate.

This important discovery was forgotten after the war, and had to be rediscovered in World War I (1914-1918). House flies actually emerged in World War I as benefactors. Military surgeons deliberately used sterile, laboratory-reared maggots to treat stubborn infections such as the lesions associated with osteomyelitis.[60] Maggot therapy disappeared in World War II (1939-1945) due to the advent of penicillin.

Malaria

'Malaria is the great fever disease.... [It] was recognized as man's worst enemy even worse than man himself.'[61] One of history's deadliest diseases, malaria has killed more people than the Black Death or outbreaks of smallpox or the 1918 influenza pandemic.

Malaria (Italian *mala aria*, or bad air), also known as ague or 'the shakes,' is characterized by sudden paroxysms of severe chills, chattering teeth, high fever (~105 °F), and profuse sweating separated by afebrile intervals of 24 (quotidian), 48 (tertian), and 72 (quartan) hours. These seemingly odd terms arose by counting the day of the paroxysm as the first day of the cycle.[62] Even though the signs and symptoms of malaria were well established in the early nineteenth century, its origin and spread remained a mystery until the epochal discoveries of Alphonse Laveran (1845-1922; Nobel Prize 1907) and Ronald Ross (1857-1932; Nobel Prize 1902) unmasked the myths. In 1880 French army surgeon Laveran found that malaria is caused by protozoan parasites of the genus *Plasmodium*, and in 1898 Ross, a British medical officer with the Indian Medical Service, demonstrated that the disease was transmitted by the bite of infected female mosquitoes of the genus *Anopheles*.[63]

Malaria was the second most common camp disease in the Union army; the alvine fluxes, known colloquially by that marvelously graphic term “the quickstep,” had the dubious distinction of first-place honors. There were more than 1.4 million cases of malaria, resulting in more than 15,000 deaths during the four-year conflict.[64] There is evidence that the Confederate states, where malaria was endemic before the war, suffered a similar fate. For example, The Department of South Carolina, Georgia, and Florida, with a mean strength of 25,723 troops, reported 41,539 cases of malaria with 227 deaths from January 1862 to July 1863.[65] In contrast to the North, Confederate medical records for the entire war are incomplete, since most of them were destroyed on 2 April 1865 when Richmond was torched by Rebels evacuating the city.

Quinine, mainly in the form of quinine sulfate (sulphate of quinia), was one of the few demonstrably effective drugs of the Civil War. First isolated from cinchona bark (Family: Rubiaceae; Genus: Cinchona) in 1820, quinine was used to treat malaria and other fevers. It is now known that malarial parasites grow inside the human host’s red blood cells, causing them to rupture and release toxic substances that cause the cyclic fever paroxysms. Quinine prevents the fever by destroying the intracellular intermediates in the plasmodium’s life cycle. In all, the Union army used a total of 19 tons of quinine sulfate and 9.5 tons of powdered cinchona bark.[66] Quinine was given prophylactically to Union troops. Since its taste is extremely bitter, quinine was dissolved in whiskey to make it more palatable. Soldiers received a daily ration of four fluid ounces of whiskey containing two to four grains of quinine.[67]

Joseph Jones, recognizing that ‘an army may be rendered almost as ineffective by sickness as by death,’ recommended that the Confederacy issue quinine prophylactically.

Southern troops were to be issued three to five grains of quinine sulfate mixed with brandy and water twice a day.[68] However, the scarcity of the drug and its high cost precluded its use on a large scale.[69]

While northern manufacturers, chiefly in Pennsylvania and New York, produced an abundance of quinine for military and civilian use, the South had to rely on foreign supplies of this specific. There were no quinine manufacturing facilities within the Confederacy. The Union naval blockade of southern ports during the Civil War produced serious shortages of quinine. When smuggled in by blockade-runners, the drug was either prohibitively expensive ($400-$600/oz. compared to $5/oz. in New York) or highly adulterated.[70] Therefore, Confederate medical officers searched for indigenous plant substitutes. An obvious starting choice was oil of turpentine, which was plentiful throughout the antebellum South. In North Carolina alone, about 800,000 barrels of turpentine were manufactured annually.[71] Comments from a respected medical botanist further strengthened the choice.

Confederate Surg. Gen. Samuel Preston Moore (1813-1889) directed physician and botanist Francis Peyre Porcher (1825-1895) to prepare a treatise on native trees, plants and shrubs that may have medicinal properties which could be substituted for drugs in increasingly short supply. The resulting book, *Resources of the Southern Fields and Forests* (1863), praised turpentine for being one of the most universally employed remedial agents, and its source *P. palustris* as 'one of the great gifts of God to man.' Porcher speculated that turpentine's odor alone had the power to diminish the effects of malaria.[72]

A report in the first issue (Jan. 1864) of the short-lived *Confederate States Medical and Surgical Journal* suggested that stupes moistened with oil of turpentine applied to the lower part of the chest was a satisfactory substitute for internally administered quinine as an antimalarial.

When applied a half-hour before the anticipated paroxysm, the expected chill failed to occur in all seven patients so treated.[73] Several months later, an editorial in the same journal by Surgeon General Moore refuted these results. After reviewing the sick reports of more than 400 cases of malaria treated with oil of turpentine in the South's military hospitals, Moore concluded, 'The terebinthinate externally applied ... may be rendered useful in the treatment of periodic fever as an adjuvant to other remedies, but that it does not deserve to be regarded as a specific in the treatment of such affections.'[74]

Modern readers, judging the past by present standards, may find it ludicrous to expect that external application of oil of turpentine could alter the course of an endogenous parasitic infection. But, in defense of the Confederate medical corps, these men were desperate. Anything, no matter how far-fetched it appears today, was worth a try. Most importantly, it must be remembered that 'the Civil War took place at the very end of the medical "middle ages"'[75] The Confederates did not have the advantage of two *fin de siècle* discoveries that were indispensable for instituting rational methods of prevention and treatment; viz., the germ theory of disease, and the principle of insect transmission of parasites.

Epilogue

By the beginning of the twentieth century, oil of turpentine had lost its preeminent place in the therapeutic armamentarium, having been supplanted by safer and more effective medicines. For example, Almroth Wright's (1861-1947) introduction in 1900 of antityphoid inoculations – using a *killed*-bacteria vaccine, departing from Louis Pasteur's (1822-1895) principle of using *living*, attenuated cultures -- made the issue of chemotherapy for typhoid moot.[76] This vaccine has been credited with substantially reducing the typhoid death rate in World War I.[77]

Currently, oil of turpentine is an inactive ingredient in the over-the-counter topical ointment Vicks VapoRub® which, when applied to the chest, back and neck, acts to suppress cough due to the common cold. In addition, a derivative of oil of turpentine, terpin hydrate elixir, has been prescribed as an expectorant in cases of bronchitis and pneumonia.[78] Outside of these few minor medicinal applications, turpentine is now relegated to the hardware store where it is sold as a paint solvent.

Table 1. Recipe for Johnson's Turpentine Emulsion

Ingredient	Wt. (dr.)*
Oil of Turpentine	3.0
Oil of Wintergreen	0.5
Tincture of Opium	4.0
Acacia Powder	4.0
Water to	4.0 oz.

Mix **Directions:** One teaspoon every 1-2 hours

*Drachms. Apothecaries Weight. Liquids were measured gravimetrically rather than volumetrically.[79]

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