The SOCIETY newsletter “MITHRIDATA” is published every six months, with issues in January and July of each year.

INSTRUCTIONS FOR AUTHORS

Deadlines for receipt of materials, for inclusion in respective issues, are December 1st, and June 1st. Manuscripts of articles being submitted for publication should be sent to the Editor as clearly typed documents, accompanied by the same material in WORD PERFECT(R) or ASCII format, on 3.5 inch diskette readable by a personal computer running WINDOWS 95.

NEW MEMBERS

We would like to welcome the following new members to “THiS”. Their names and interests will be added to the 2001 Directory. Each new member is expected to contribute to the SOCIETY by research in their area of interests, which will lead to presentations at SOCIETY meetings, or articles for “MITHRIDATA”.

<table>
<thead>
<tr>
<th>NAME</th>
<th>LOCATION</th>
<th>INTERESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kathleen Lanc, RN</td>
<td>Lackawanna, NEW YORK</td>
<td>19th Century medicine</td>
</tr>
<tr>
<td>Carolyn Lee, RPh</td>
<td>West Monroe, LOUISIANA</td>
<td>Biohazards, snake bites</td>
</tr>
</tbody>
</table>

NEWS NOTES

“MITHRIDATA” - THE FIRST TEN YEARS

The first ten years of our newsletter (1991-2000), covering 20 issues, have been reproduced, and bound as a single volume. To obtain a copy of the collection, please send US$15.00, to cover the cost of duplication and postage. Make checks payable to Regional Poison Center. This is an excellent opportunity for newer members to catch up with the past works published by our SOCIETY!
At the height of its fame from the eighth century BC to the fifth century BC, the Oracle at Delphi, in the Temple of Apollo, was the most prestigious in the Mediterranean. Gifts from those who consulted the oracle made the mountain village one of the richest sites in Ancient Greece. The Oracle was of such importance that it was consulted before new colonies were founded, wars were declared or changes in government were made. The Ancient Greeks believed that the power of the Delphic Oracle derived from the location of the temple. According to reliable texts, including eyewitness accounts from temple priests, the priestess who spoke the prophecies (the Pythia) sat on a tripod that spanned a fissure or cleft in the rock within a recessed portion of the temple of Apollo. Vapors rose from this chasm into the inner sanctum or “adyton”, where they intoxicated the Pythia, produced her “frenzy” and inspired her prophecies. Only the Pythia entered and remained in the adyton. However, in modern times there has been a controversy concerning the source of the prophetic powers of the Oracle at Delphi. The ancient testimonies have been challenged after an archeological dig during the early 20th century failed to locate any cleft or source of vapors within the foundations of the ruined temple and therefor concluded that the ancient sources must have been in error. Additionally they concluded that the geology of the area was not of volcanic origin and therefor there was no geological defense of gaseous vents persisting for centuries. There are at least two major problems with this modern assessment and conclusion. First, the initial excavation did not reach bedrock and therefor may not have reached the lower sections of the temple where the Adyton was reported to be. Second, while they were correct that the area is not a source of volcanic activity, a recent geologic study of the sanctuary and adjacent areas (including a site visit and satellite data) has shown that the temple lies directly over a tectonic fault. Recent studies support that the preconditions for emissions of intoxicating fumes, with the most likely candidate being the hydrocarbon gas and general anesthetic ethylene, were indeed present at Delphi. This paper will use a combination of the ancient text, geological evidence and modern understanding of the properties of anesthetic gases to defend the argument that the prophesies of the Pythias in fact occurred after an intoxication from gases of geological origin.

“Phosphorus Necrosis of the Jaw in Matchmakers: An Extinct Occupational Disease”

by

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In 1669, the German alchemist Hennig Brand, discovered phosphorus. His discovery burned spontaneously and glowed in the dark. Later that century, the English chemist Robert Boyle described a mixture of sulfur and phosphorus that easily ignited with friction. In 1826, the English pharmacist John Walker invented the first friction match (not containing phosphorus). Although not containing phosphorus his invention let to the development of phosphorus friction matches. By the 1830s, Charles Sauria of France, Jacob Kammerer of Germany and Janos Irinyi of Hungary had each successfully applied white phosphorus to the tips of matches. With the successful development of commercially viable product, match manufacturers arose throughout Europe and the United States. By 1845, however, the first report of phosphornekrose (phosphorus necrosis) appeared. Authored by Viennese physician, Friedrich Wilhelm Lorinser, the report documented
cases of phosphorus necrosis dating back to 1839. Four of his patients had developed total necrosis of the maxilla, two had complete mandibular involvement. Despite the discovery of nontoxic red phosphorus (and its application to matches in the 1840s), white phosphorus matches remained popular due to their low cost and reliability. Meanwhile, workers continued to succumb to the disfiguring and frequently deadly disease associated with the manufacture of matches. By the 1870s, however, countries in Europe began to ban production of white phosphorus matches. Starting with Finland in 1872 and concluding with the signing of an international treaty in 1906, much of the world prohibited the manufacture, importation and sale of matches containing white phosphorus. It was not until 1913, though, that the United States banned the manufacture of white phosphorus matches. This report will briefly document the history of the production of phosphorus matches to serve as a backdrop to the story of phosphorus necrosis of the jaw. This occupational disease afflicted not only men and women but also the many young children engaged in the manufacture of matches. Although the toll of the disease is unknown, the medical record of this disease serves as a reminder of the need for continued vigilance on the part of physicians and toxicologists around the world.

"Phosphorus Murders: of Friction, Fission and Fiction"
by
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Background: Phosphorus, an essential element that glows in the dark, is nowadays a chemical staple sold by the ton load for fertilizer, food, and pesticide industries. During the industrial era, mass-production of the flammable and supertoxic yellow (white) form of phosphorus (YP) necessary for matchmaking, soon resulted in YP being found in every household. Thus also started YP’s criminal history. Method: Readily available relevant French and English literature was thoroughly reviewed. Results: Around 1830, the sale of friction matches and rodenticide pastes, sources of dangerous YP, became widespread and totally unregulated. YP is said to have replaced arsenic more than once, as the criminal poison of choice, when the Arsenic Act was enacted by British Parliament, in 1851. Murder attempts sometimes failed when the poisoner's victim was tipped off by YP’s telltale fumes, eerish phosphorescence, garlicky odor and taste. Efforts were made to deter criminals from using match heads as a YP source. Indeed once absorbed, without the classic aforementioned signs, or a clear exposure history, YP would often elude diagnosis, even after death, since oxidized YP (phosphate) is a normal body and food constituent, unlike arsenic. The Scherer and Mitscherlich chemical detection tests for YP were then popular. At least 16 murders using YP could be tracked back to 1843. Female YP murderers and victims prevail over males, in the proportions of 8:4 and 8:6. The victim was a relative in 12 cases, most often the spouse (9). Murder motive was most often financial (6 cases), followed by adultery (3), hatred (1), and blackmail (1). Of at least nine defendants tried (2 couples, 2 males, 3 females), two women were hanged, three had their sentences commuted to life imprisonment and three men were acquitted. Pesticide pastes (1-3% YP) as instrument of murder, prevail by 9:1 over match heads in our series. Non toxic red phosphorus replaced progressively YP in most matches after the 1906 Berne Treaty. YP pesticide pastes were phased out in Canada, the UK (since 1963) and the US. At the end of World War II, the Nuremberg Trial judged Nazi war criminals for having inflicted deadly YP skin burns on unwilling Ravensbruck and Buchenwald concentration camp prisoners. In 1995, another kind of "phosphorus poisoning" occurred in US research laboratories; a drinking water cooler tank was deliberately contaminated with radioactive phosphorus (P-32), a fission product. Finally, murder by YP poisoning is depicted in at least 5 works of fiction: one novel, and four movies. Conclusion: availability to the public of YP has decreased in the last 350 years. However toxicologists should keep in mind that this formidable poison is still used in the chemical, military and developing countries settings.

“A History of Healthcare Poisoners, and a Proposal to Detect and Stop Serial Healthcare Poisoners.”
by
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Healthcare poisoners can be broadly classed as belonging to one of two groups: (1) the profit killer, who kills a single victim or a number of victims in a single killing spree and whose motivation is usually easily understood in terms of personal gain—money, freedom from a spouse, jealousy, individual hatred, political ideology, etc; and (2) the serial healthcare poisoner, who fits the classic definition of the serial killer: Two or more victims in incidents that are physically and temporally unrelated. The motives of this last group are also more difficult to determine and understand. Healthcare murderers are rare—we have identified only 118 cases since 1823—but, in the case of the serial murderers, the number of
victims per killer may range into the hundreds. Given their medical expertise and intellectual and social smugness, a common trait that many physician profit poisoners share is their belief that they can “get away with it.” For example, George Henry Lamson, like many of the celebrated 19th century physician poisoners, murdered for financial gain. He killed his disabled brother-in-law by serving him cake laced with aconite. While little was known about aconite at the time, and a biological assay had not been developed, Lamson was convicted and sentenced to death after experimental evidence was introduced that revealed that vomitus from the deceased and aconite extracts produced similar effects. Another physician poisoner who thought he had committed the perfect murder was Robert Buchanan. Buchanan, who employed morphine to kill his wealthy second wife, attempted to disguise the tell tale sign of miosis by instilling belladonna directly into the eyes. During his trial it was demonstrated in a cat that belladonna prevented the miosis typically induced with a lethal morphine dose. Buchanan was electrocuted as a result. More recently, in 1965, Carl Coppolino, an anesthesiologist, murdered his physician wife with succinylcholine in order to marry his mistress. Despite a spirited defense by F. Lee Bailey, Coppolino was convicted of murder - the first acknowledged case of murder by succinylcholine - and sentenced to life in prison. Seventy of the 118 healthcare poisoners are considered serial murderers and all have used poisoning or, occasionally, asphyxiation as their method. Ten serial healthcare poisoners (14%) are currently pending trial. Indeed 76% of all known serial healthcare poisoners have been detected since 1980, and 59% of the total since 1990. An increased awareness of the phenomenon of healthcare serial killers, better chemical analytic capabilities and general improvements in criminal detection are partially to credit for the increased numbers detected, but, as with serial killers in general, there appears to be an absolute increase in the incidence of this type of crime. The true incidence of such crimes and the number of such individuals currently “at work” is unknown. Just from those who have been apprehended, we can account for greater than 1,000 victims of serial healthcare poisoners over the last decade. Homicide by poison (HBP) is difficult to detect and made more so by the lack of proper monitoring of death rates and patterns in healthcare institutions and geographic regions, and the lack of routine toxicology testing in institutional deaths. And although considerable profiling has been done of non-healthcare serial killers, there are no systematic studies of serial healthcare poisoners. Some differences between healthcare and non-healthcare murderers have been observed. For example, only a few examples of non-healthcare female serial murderers exist. And while females make up only 14% of all non-serial healthcare poisoners (comparable to their proportion of non-serial murderers in the general population), they comprise 41% of serial healthcare poisoners, suggesting a unique dynamic. It is likely, as with non-healthcare serial killers, and given such diverse cases as that of Michael Swango, Harold Shipman, Kristen Gilbert, Efran Salvidar, Orville Lynn Majors, Wouter Basson, Christine Malevre and Hu Wanlin, that they are not an homogenous group. A methodology to detect and interrupt the activities of serial poisoners at earlier points in their careers should embody at least three elements. (1) In order to gain a better understanding of these individuals, and perhaps to more quickly identify a suspect once it has been determined that a serial healthcare poisoner has been in operation, a healthcare poisoner typology needs to be developed. Healthcare serial poisoners should be subjected to the same psychological profiling techniques that have been applied to non-healthcare serial killers. (2) Because most healthcare poisoners select their victims from those to whom they have ready access, their murders often occur in a single facility or small number of institutions within a geographic region. Although analysis of death rates and patterns correlated to work schedules is often used after the fact to build a criminal case, baseline death rates and their natural variance need to be determined within healthcare institutions and geographic regions to be able to apply prospective surveillance programs to detect abnormal death trends during the period of killing. And (3) Toxicology testing of all institutional deaths will allow identification of homicides very early in the operation of such killers as well as detect previously unsuspected non-serial HBP (estimated at 2 to 3 per 100,000 population). Although there would be a considerable cost, the prevention of deaths from serial healthcare poisoners and the detection of previously unsuspected other HBP would create a cost/benefit ratio clearly in favor of this approach.

“Unit 731- Biological War Crimes and the Japanese Imperial Army”

by

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In January, 1948, a man entered the Teikoku Bank in Tokyo, Japan, identifying himself as an official of the Ministry of Health. He advised the bank manager of a "disease epidemic" in the area and that all employees needed to drink a preventive medicine; an antidote, that he had brought with him. The man then pipetted the liquid contents of a bottle he had brought and placed some into a tea cup. He demonstrated to the bank employees how the medicine should be swallowed, and even swallowed some himself. He then dispensed the liquid into sixteen tea cups, one for each bank employee. On command, they all drank the "medicine". Twelve bank employees died quickly; four survived. Autopsies
performed at Japanese universities suggested that the poison used was Acetone cyanohydrin, a poison that had been intensively studied by the infamous biological research unit of the Japanese Imperial Army, *Unit 731*. Although the poisoning murders at the *Teikoku Bank* have never been conclusively resolved, the question has lingered as to whether or not one or more members of *Unit 731* were somehow involved. Some of the most heinous deeds carried out in the far Eastern theaters during *World War II* did not take place on the battlefield. That distinction falls to the Imperial Japanese Army's *Unit 731*, under the command of General Ishii Shiro. This military unit, based in remote areas of mainland China, carried out horrifically inhumane human experiments using biological agents including plague bacillus, cholera, epidemic hemorrhagic fever viruses and typhus, among others. The victims were generally hapless Chinese peasants who were kidnapped by the Imperial Army (as well as American prisoners of war). Following infection with these microbes, humans under went cruel surgical exploration as well as various and sundry questionable clinical "investigations", usually without the use of any anesthesia. Shockingly, *Unit 731* had even planned extensively for biological attacks against the U.S. mainland in order to win the war. The end of the war saw the demise of *Unit 731* but in order to prevent the essential elements of Japan's biological program from falling to the Soviets, the U.S. military granted clemency to the *Unit 731* war criminals, many of whom lived out their days, unpunished, in relative anonymity in post war Japan.

**FEATURE ARTICLES**

**“Venomous Snake Bites and Remedies over the Millennia”**

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From the rattlesnakes of the Americas, across the oceans, to the mambas and cobras of the African and Asian continents, and on to those deadly serpents from the land “down under”, human fascination with venomous snakes and the consequences of their bites has been a global affair.

Nearly four millennia ago snakebite victims were treated by Egyptian priests, who would lay open their bitten extremities to allow the escape of evil spirits (Russell, 1983). The *Eber’s Papyrus*, written around 1550 B.C., tells a tale from Egyptian mythology in which Ra, the sun god, stepped on a snake, was bitten and became “cold as water and then again as hot as fire” (Minton & Minton, 1980). Approximately 1500 B.C. the first known snake shamans, the *Psylli* of North Africa, were described by Pliny the Elder. It was the *Psylli* who were summoned to save Cleopatra from her suicide by asp envenomation. Their chanting and incantations were obviously unsuccessful, as Cleopatra died from snake venom poisoning, on August 12, 30 B.C., at the age of 39 (Minton & Minton, 1980). These were the early years of venomous snakebite and the beginnings of a resplendent medical history. Over the following millennia a plethora of crude and creative remedies evolved, with snakebite victim survival often somewhat of a supernatural event.

Of the earlier known treatments for snakebite, scarification by cutting through the fang punctures and associated areas, excision of the bite site and amputation were predominant practices. Nicander of Colophon, in the second century B.C., mentions the use of snake teeth as the cutting tool for making scar-like incisions. Their use was believed of value because opening the wound allowed the escape of “demons” responsible for the ill effects instilled by the serpent. These techniques were performed during ancient times in both Egyptian and Chinese cultures (Klauber, 1956; Russell, 1983).

One philosophy of ancient times was that the serpents themselves, possessed within their bodies, the powers to cure against their own poison. This was the partial reasoning behind the development of *Theriaca*, later known as *Mithridate* or *Venice Treacle*. *Theriaca* was a prescription compounded of many ingredients and developed as somewhat of a universal antidote. Around 400 B.C. Aristotle used mashed snakeheads and livers, which would be eaten or placed on the bitten area. In the first century A.D. Andromachus, physician to the Roman Emperor Nero, added viper flesh to the ancient cocktail. He also added opium which may have had an important role in the symptomatic treatment of snakebite (Minton & Minton, 1980; Russell, 1983). Pliny (23–79 A.D.) reported the use of powdered human teeth placed on snakebite wounds. It is also known that during the 1700s the American Indians of the Niagara Falls region, used powdered crawfish on snakebites while others on the west coast were reported to have used powdered crocodile teeth, believed to have been introduced by the Europeans and derived from ancient Egyptians (Klauber, 1956). In the 1800s and
early 1900s the highly prized snake oils came into use and appear to be the closing era of snakebite remedies derived from the consumption or application of snake parts.

“Cut and suck”, most notoriously used during the 1850s, was originally used around 200 B.C. (Russell, 1983). Even the use of leeches was employed as a method of suction during ancient times. In 1198, Maimonides, the sultan of Egypt’s personal physician, described the making of incisions around, and distant to, the bite with the application of oral suction to remove venom (Hale, 1992). However, the classical cutting of “X-X” incisions over the bite can be traced to H.C. Yarrow, a U.S. army surgeon during the mid to late 1800s. After incising the area, the mouth was commonly used to “withdraw” the poison. Incision and suction were the standard of practice for a sustained period of time. Dr. Findlay Russell gave testimonial to the wide use of these practices when he quoted from the 1833, American Frugal Housewife: “Cut the flesh out, around the bite, instantly; that the poison may not have time to circulate in the blood” (Russell, 1983).

The cut and suction method underwent still another revision in the 1920s when Dr. Dudley Jackson of San Antonio, Texas, promoted the practice of making multiple cruciform incisions around the bite with suction bulbs placed over each incision. As many as 100 incisions were used with suction on each one, for 20 minutes out of each hour, for up to 36 hours. This procedure was further modified by Pope and Peterson who tested suction on the envenomed limbs of dogs by placing the entire limb in a jar, sealing around the limb and evacuating it. They termed this “negative pressure” rather than suction (Pope & Peterson, 1946). More recently this concept was simplified by eliminating the multiple incisions and applying negative pressure directly over cuts made above the fang punctures. This combination of negative pressure and suction was widely used during the twentieth century as evidenced by the suction cups/bulbs which were the mainstay of Cutter® and B & D® snakebite first aid kits. Today the more refined Extractor® has become a commonly used device in first aid for snakebite.

Without a doubt, a most intense phase of invasive measures used in snakebite history presented in the 1960s with the promotion of fasciotomy by the Texas surgeon, Thomas Glass. This procedure was believed necessary to save the bitten limb in which circulation and nerve function were severely compromised by increased compartment pressure. In 1991 Dr. Glass made his final published contribution advocating surgical management of poisonous snakebite, which continues to serve as an active reference for some physicians (Glass, 1991). Other “surgical procedures” over the years, as interpreted by “local experts”, have been primarily “blue-blooded” acts as demonstrated by such measures as chopping off bitten fingers and toes with a hatchet, or even blasting off the bitten digit with a gun (Minton & Minton, 1980). Thus, whether treatment is by a trained physician, the “local expert”, or “self-inflicted”, modern day snakebite victims can still suffer the haunting long-term results of various “surgical” interventions.

The idea of retarding venom spread or absorption with the use of ligatures and/or chilling of the bitten area was used for snakebite in ancient times. Maimonides commented on ligature usage for snakebite in 1198, and Obel referred to the use of hot/cold in 1570. These were popularized as remedies for the cure of snakebite at the turn of the twentieth century (Russell, 1983). C.W.R. Crum promoted cryotherapy for retarding venom spread from bites on parts of the body where ligature was not possible (Minton & Minton, 1980). Dr. Prentice Wilson, in 1908, recommended a series of ligatures between the bite and heart, of which at least one should be applied to that segment of the limb containing one bone (Wilson, 1908). A second major resurgence in the use of these treatments occurred in the early 1950s, as a result of the philosophy of Herbert Stahnke, Director of the Poisonous Animals Research Lab, at Arizona State University. Commonly referred to as the L-C method, Stahnke recommended application of a ligature and placement of ice on the wound, followed by placement of the limb in a crushed ice water bath above the ligature, waiting 10 minutes before removal of the ligature, but keeping the limb emerged in ice water for 12 hours up to days (Stahnke, 1953). Not surprisingly, Stahnke’s L-C method resulted in some of the most morbid outcomes reported in snakebite treatment history!

The array of drugs, biochemical compounds and chemicals used as snake venom antidotes with a chronicled past is astounding, and is represented by nearly the entire Periodic Table. Drugs such as adrenaline, hydrocortisone, glutathione, EDTA, pyridoxine, nicotine, and strychnine were all put to the test as a cure for snakebite. Similarly, various salts, ammonia, sodium bisulfite, indigo, volatile alkali, iodine, gold preparations, Congo red, methylene blue, carbon-free India ink, and even gun powder were used to destroy the integrity of venom, with the hope of preventing its consequential effects. Unbelievably, these represent just a small fraction of the “chemical cure” spectrum (Russell & Scharffenberg, 1964). It is noteworthy that the most popular compound was probably potassium permanganate, commonly used and referred to as Carnoy’s fluid, which was used by British physicians during the 1860s in treating cobra bite victims in
India. Two decades later, in 1881, de Lacerda noted its ability to destroy venom in a test tube and was soon recommended for injection into tissues around the bite (Minton & Minton, 1980). This resulted in extensive tissue destruction without neutralization of venom in tissues. Despite the drawbacks to its use, potassium permanganate was a component of snakebite first aid kits in the United States until the mid-1930s (Klauber, 1956). Fortunately, the use of chemicals for snakebite therapy is no longer a viable practice today.

Among remedies, it has been the folk remedies which have provided colorful contributions to the snakebite treatment literature. Commonly passed on by word of mouth, they are almost all purely anecdotal in nature. One of the more bizarre, and truly novel remedies, was the “split-chicken treatment”. A freshly killed, split-open chicken was used as a poultice over the bitten area. When the flesh turned green or black, from absorption of the venom, the chicken’s comb turned blue, or the chicken lost its feathers, the victim was cured. This practice commonly involved the splitting open of almost any available creature and had its followers late into the nineteenth century (Klauber, 1956; Russell, 1983).

Not to be outdone by folk remedies but equally as colorful in history was ethanol. Of all the medications or remedies used to treat victims of venomous snakebite victims, perhaps none has been more ubiquitously and liberally used, and misused, than the internal use of alcohol! Celsus (53 B.C. – 7 A.D.) used strong wine, sometimes with pepper added (Minton & Minton). Although alcohol and venomous snakebite have been linked as far back as 185 B.C., its use reached a crescendo during colonial times and into the nineteenth century in the United States. Large quantities of whiskey (White Lightning, Ever-Clear, White Mule, Red Eye, etc…) were the order of the day (Russell, 1983). In 1854 Dr. Burnett, a Wisconsin physician, declared snake venom a depressant, and alcohol a powerful stimulant, and thus regardless of the quantity of whiskey consumed, intoxication did not follow. As attested to by a Fennimore, Wisconsin, gentleman who confessed to Bishop Kemper after being bitten by a rattlesnake: “I drank half a pint of alcohol and camphor, then a quart of whiskey, followed by a quart of pure alcohol”, and all this with no symptoms of intoxication (Schorger, 1967-68). Three decades later, for the 1886 edition of the American Naturalist, George Foster, son of the famous Revolutionary General Foster, told of how his father kept a pet rattlesnake. One night while reaching for a match he was bitten. “He happened to be full of liquor at the time, so it did not kill him” (Babcock, 1928). Quite simply, the primary alcohol dosing protocol was, if you still felt the effects of venom, you hadn’t drunk enough whiskey. Finally, in 1895-96, Francis published his paper, “The Uselessness of Alcohol in Snakebite”, however, there were still those who adhered to the liquor cure for snakebite (Francis, 1895-1896). Perhaps W.C. Fields summed up the ethanol linkage between humans and snakes best when he said, “I always keep a supply of stimulant handy in case I see a snake – which I also keep handy”. Unfortunately, even today, alcohol still plays a key role in snakebite, albeit causative rather than curative.

Certain stones from the Far East derived their identity from not only their use in the treatment of snakebite, but because their source was purported to be from the skulls of certain “hooded cobra serpents”. Snakestones, called piedras della cobra de Capelos, were greenish/reddish, lenticular shaped, and the size of a small Italian coin. A stone was placed on the snakebite so it would stick to the wound and then: “having drained off all the poison, it fell away by itself, like a leech saturated with blood”. A great scientific dispute of the 1660s-1670s between Italians Athanasius Kircher, natural philosopher and curator of the Jesuit Museum at the Collegio Romano, and Francesco Redi, a Tuscan court physician and superintendent of the ducal pharmacy, revolved around the effectiveness of medicinal stones for treating viper bites (Baldwin, 1995). In 1663 Kircher originally tested his stone on a dog “in front of amazed spectators”. Coincidentally, at the same time, a local peasant suffered a viper bite during the harvest season and a second test was conducted by another Roman, Carlo Magnini. Both the dog and the peasant lived. Redi attempted a counter of Kircher’s findings; however, he was not able to test his snakestones on snakebite victims because cold weather had hindered the court’s most skilled viper catcher from producing any specimens. Consequently, Redi conducted his initial experiments using the toxin, oil of tobacco, and roosters. Thread soaked in the toxic oil and attached to needles was stabbed into the avian thighs. Snakestones were applied, and they stuck just as Kircher had related. Unfortunately, the gathering of physicians and natural philosophers were audience to a resounding failure as the first two cocks were consumed by death, and the third would not become toxic. The third cock was dosed repeatedly until succumbing to the poison, however he was restored to life by the next morning. Redi repeated experiments, using vipers, without success, while Kircher held fast to his two original claims. The professional rivalry was intense and the dispute, although diplomatic, soon involved a lawyer, but was never resolved (Baldwin, 1995). Interestingly, in a 1996 letter to the editor of the American Journal of Emergency Medicine, it was reported that 1,637 registered voluntary health organizations in India have used snakestones with a 95-98% success rate (Rasquinha, 1996).
Equally as fascinating as snakestones has been the use of electric shock. First tested by Fontana as a static discharge for viper bite in 1787, and later in 1872 by Fayer using “galvanism” electrotherapy as a possible snakebite treatment. Its more recent surge of interest stemmed from a 1986 letter published in The Lancet by a missionary doctor, Ronald Guiderian (Guiderian et al., 1986). Using a spark plug cable from an outboard boat motor, running at half-throttle, snake bitten victims were given five, one-second high voltage, low amperage shocks. Consequently, the treatment became the panacea for treating venomous snakebite. This also led to advertising and testimonial accounts in Outdoor Life magazine and other sportsman publications, promoting the use of “stun guns” and leading to the development of the special model for treating snakebite, the “Snake Doctor”. The consequences of such treatment were astounding. In 1991, Dart reported of a victim treating himself for snakebite to the lip by lying down next to the car, attaching a spark plug wire to his upper lip with clips, and having a friend repeatedly rev the car engine to 3000 rpms. Following the first rev-up the victim lost consciousness, however he survived (Dart, 1991)! Again, this is a case which demonstrates the amazing ability of humans to survive a truly bizarre snakebite treatment. Fortunately, at present, there is a lull in the arena of electrotherapy in the treatment of snakebite, although a few surprises for emergency department staff are probably still to come.

Less detrimental than electrotherapeutics, possibly more rational in use, and possessing a history of use covering many thousands of years has been the practice of ethnomedicine, involving the use of herbs in treating snakebite victims. The number of botanics associated with snakebite treatment is immense, involving thousands of species of plants (Houghton, 1993). Herbs or their sap were commonly applied to the snakebite area or consumed internally. In many instances, herbs were used in combination with other therapies such as ligatures or even alcohol during colonial times. North American Indians used Echinacea, root of coneflower, orally for snakebite and a hypodermic form was even listed as a snakebite therapy in the Pharmacopeia (Klauber, 1953). Indians of the New Jersey Pine Barrens, used the leaves of the Rattlesnake Plantain (Peranatiom pubescens) applied externally or swallowed. They were so sure of its curative power to protect them against the effects of snakebite that they would allow themselves to be bitten for a shilling (Smith, 1765). Many species of plants, such as Rauwolfia serpentina, possess tranquilizing properties, which may have contributed to their supposed benefit in treating snakebite. The use of botanicals persists in countries such as Papua New Guinea where the Manaka and Kar tribes chew the bark and swallow the juices of “kond”, a native mango tree (Mangifera minor), as a treatment for bite by the death adder and the small-eyed snake (Mebs, 2000). The quest for ethnopharmacological cures, including those for snakebite, continues in the Americas, Africa, Asia, Australia and most tropical regions of the world with the possibility of many new discoveries on the horizon.

Ophiolatry, the practice of serpent worship, has also had its place in the history of snakebite and has spanned the years of mankind. Although snakes have been worshiped by most of the world’s major societies, a new custom evolved during the early twentieth century in the United States. In 1906, in Grasshopper Valley, Tennessee, a fundamentalist Christian church began the practice of handling venomous snakes during their worship service (Rubio, 1998). The congregational members were doing what the book of Mark (16:17-18) directed them to do, “they shall pick up serpents”. As was commonly believed when a bite occurs, “if God don’t want me to die with a snakebite, he will not let me die”. There have been 74 deaths since the practice was begun, and it is obvious prayer does not save everyone bitten by a venomous snake (Larson, 1995). None-the-less, snake handling continues in many churches of the southern United States, despite laws prohibiting the practice, and future fatalities are likely.

Given the multitude of therapies tried over the millennia, most of limited therapeutic value in treating snakebite victims, it was the concept of serotherapy and the development of antipholic serum that finally provided a rational envenomation treatment. As novel as this approach appeared to be, a method had been practiced in India for hundreds of years using an unrefined immunization process. Scarification was performed in specific patterns, commonly on the arms, using mixtures of crude venoms. This resulted in the individual being resistant to the effects of envenomation (Tin-Myint, 1991). Only a century ago in 1887, Henry Sewell at the University of Michigan, began injecting pigeons with escalating doses of massasauga venom. He found that the birds could soon survive a venom challenge several times the lethal dose. Thus, active immunization had occurred. In 1894 Phisalix and Bertrand, at the Museum of Natural History in Paris, discovered that serum from an immunized guinea pig could be transferred to another guinea pig with the recipient being protected from snake venom effects. They also discovered venom detoxified by exposure to heat still retained its immunizing properties. In 1895 Fraser determined the protective component against snake venom was harbored in the serum fraction of the immunized animal (Klauber, 1956). Thus, the stage was set in 1897 for Dr. Albert Calmette, of the Pasteur Institute in Paris, to produce his “serum antivenimeux” by immunization of horses with cobra venom and harvesting their serum for worldwide marketing (Hawgood, 1999). This first true antivenom was initially supplied to
India where it was most needed. Calmette also discovered that antiserum would provide paraspecific coverage against the effects of different venoms. Shortly following the work of Calmette, Dr. Frank Tidswell of Australia developed the first tiger snake antivenin using a retired ambulance horse (Sutherland, 1994). In the New World, Vital Brazil, a medical science pioneer and humanitarian with great personal concern for the common laborer working the land in South America, was motivated by Calmette’s work to produce the first Crotalus antivenin (Hawgood, 1992). Two years following Brazil’s rattlesnake antivenin development, Flexner and Noguchi created the first rattlesnake antivenin in the United States in 1903. However, it was 20 years before a product was produced by Mulford Biological Laboratories and made available by the formation of the Antivenin Institute of America in 1926 (Palmer, 1992). Over the decades of the mid twentieth century, monovalent and polyvalent antivenins were developed and refined. Today these are produced by many countries. Recent technological advancements have allowed for the further refining of antibody therapy, leading to the development of smaller antibody fragments (Fab) produced in nonequine species such as sheep, with the potential for reduced side effects. These refined immunological products have truly placed themselves at the top of the snakebite treatment ladder and represent major advances in venomous snakebite treatment.

In conclusion, it would appear that the overall timeline of treatments for snake venom poisoning has gone something like this: chanting, laying on of hands, herbs, cutting, scarification and amputation, alcohol, stones, almost every chemical in the Periodic Table, ligatures, cut and suck, ice, more alcohol, more cut and suck, surgery/fasciotomy, electrotherapy, and finally immunotherapy (with any combination of the above being acceptable)! Not surprisingly, given the haphazard course of snake venom poisoning, in humans even the most bizarre remedies appeared to save life and limb.

Fontana, in 1781, a scientist well ahead of his time, supplied the words that best summarize the effectiveness of treatments for venomous snakebite over the millennia: “The physician who treats a patient with a drug and the patient recovers, assumes that which is not necessarily true; that the patient recovered because of the drug, when in reality all that the physician has proved is that the drug did not kill the patient.”

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“Akee Poisoning”

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Introduction: Akee is native to Guinea, and named after William Bligh (Blighia sapida) of the HMS Bounty, who carried many plants to different parts of the world. This tree is grown and appreciated in Jamaica and the West Indies. It is not the fruit that is edible, but the fleshy white arils (aril) is a special covering of certain seeds that commonly develops from the seed stalk. It is often a bright-colored fleshy envelope, as in such woody plants as the yews and nutmeg, and in members of the arrowroot family, the genus Oxalis, and the Castor bean. Animals are attracted to arils and eat the seeds, dispersing them in their wastes. In the Castor bean, the aril is spongy and absorbs water during germination. The aril of nutmeg is the source of the spice known as Mace. The fruit is three-angled and splits or pops open (sometimes called "yawning") when mature to reveal the black seeds, which are poisonous, and the arils. It is important that the fruit open naturally because the unripe aril is not digestible. The ripe aril can be eaten raw or immersed in boiling salt water for 15-20 minutes, until tender and bright yellow. The tree is outstanding with its racemes of white flowers and glossy evergreen leaves. It can be propagated by seed or cuttings and produces two crops a year. The tree belongs to the family Sapindaceae, and is known by several names. It is sometimes called ackee, akee apple, or vegetable brain (sosse vegetal in Spanish). Other Spanish names are arbol de seso, palo de seso (Cuba); huevo vegetal and fruto de huevo (Guatemala and Panama); arbor del huevo and pera roja (Mexico); meréy del diablo (Venezuela); bien me sabe or pan y quesito (Colombia); aki (Costa Rica). In Portuguese, it is castanha or castanheiro de Africa. In French, it is arbre fricassee or arbre a fricasser (Haiti); yeux de crabe or ris de veau (Martinique). In Surinam it is known as akie. On the Ivory Coast of West Africa, it is called kaka or finzan; in the Sudan, finza. Elsewhere in Africa it is generally known as akye, akeyen or ishin, though it has many other dialectal names. In the timber trade, the wood is marketed as achin. Historical aspects: Although today the fruit is mainly found in Jamaica, it is not indigenous to it. It was originally brought from West Africa to Jamaica sometime in the 18th Century. The name of the tree is derived a West African word Akye fufo. According to some other scholars, the name may be a corruption of the Mayan "acche" which was applied to several plants whose flowers attract honeybees. Akee was readily adopted in Jamaica and is now the its national fruit. It is commonly grown in dooryards and along roadsides and, to some extent has become naturalized. The arils still constitute a favorite food of the island and the fruit is featured in a calypso despite the health hazards associated with it. Canned arils are exported to the United Kingdom where they are welcomed by Jamaican immigrants. Importation has been banned by the United States Food and Drug Administration. The tree now grows luxuriously in Jamaica producing each year large quantities of edible fruit. Although Ackee trees are now found across the island of Jamaica, the main producing areas are located in

Introduction: Akee is native to Guinea, and named after William Bligh (Blighia sapida) of the HMS Bounty, who carried many plants to different parts of the world. This tree is grown and appreciated in Jamaica and the West Indies. It is not the fruit that is edible, but the fleshy white arils (aril) is a special covering of certain seeds that commonly develops from the seed stalk. It is often a bright-colored fleshy envelope, as in such woody plants as the yews and nutmeg, and in members of the arrowroot family, the genus Oxalis, and the Castor bean. Animals are attracted to arils and eat the seeds, dispersing them in their wastes. In the Castor bean, the aril is spongy and absorbs water during germination. The aril of nutmeg is the source of the spice known as Mace). The fruit is three-angled and splits or pops open (sometimes called "yawning") when mature to reveal the black seeds, which are poisonous, and the arils. It is important that the fruit open naturally because the unripe aril is not digestible. The ripe aril can be eaten raw or immersed in boiling salt water for 15-20 minutes, until tender and bright yellow. The tree is outstanding with its racemes of white flowers and glossy evergreen leaves. It can be propagated by seed or cuttings and produces two crops a year. The tree belongs to the family Sapindaceae, and is known by several names. It is sometimes called ackee, akee apple, or vegetable brain (sosse vegetal in Spanish). Other Spanish names are arbol de seso, palo de seso (Cuba); huevo vegetal and fruto de huevo (Guatemala and Panama); arbor del huevo and pera roja (Mexico); meréy del diablo (Venezuela); bien me sabe or pan y quesito (Colombia); aki (Costa Rica). In Portuguese, it is castanha or castanheiro de Africa. In French, it is arbre fricassee or arbre a fricasser (Haiti); yeux de crabe or ris de veau (Martinique). In Surinam it is known as akie. On the Ivory Coast of West Africa, it is called kaka or finzan; in the Sudan, finza. Elsewhere in Africa it is generally known as akye, akeyen or ishin, though it has many other dialectal names. In the timber trade, the wood is marketed as achin. Historical aspects: Although today the fruit is mainly found in Jamaica, it is not indigenous to it. It was originally brought from West Africa to Jamaica sometime in the 18th Century. The name of the tree is derived a West African word Akye fufo. According to some other scholars, the name may be a corruption of the Mayan "acche" which was applied to several plants whose flowers attract honeybees. Akee was readily adopted in Jamaica and is now the its national fruit. It is commonly grown in dooryards and along roadsides and, to some extent has become naturalized. The arils still constitute a favorite food of the island and the fruit is featured in a calypso despite the health hazards associated with it. Canned arils are exported to the United Kingdom where they are welcomed by Jamaican immigrants. Importation has been banned by the United States Food and Drug Administration. The tree now grows luxuriously in Jamaica producing each year large quantities of edible fruit. Although Ackee trees are now found across the island of Jamaica, the main producing areas are located in
Clarendon and St Elizabeth. The tree was taken to Kew, England in 1793 by Captain William Bligh of "Mutiny on the Bounty" fame (see Appendix), hence the botanical name Blighia sapida, in honor of the notorius sea captain. It was then, that the tree became known to the "known" world, and to science. One of the earliest local propagators of the tree was Dr. Thomas Clarke who introduced it to the eastern parishes in 1778. Jamaica is the only place where the fruit is generally recognized as an edible crop, although the plant has been introduced into most of the other Caribbean islands - Trinidad, Grenada, Antigua, Barbados, Central America and even Florida where it is known by different names and does not thrive in economic quantities. **Description of the tree:** The tree, reaching 33 to 40 feet (10-12 meters), is rather hand some, usually with a short trunk of 6 feet (1.8 meters) in circumference, and a dense crown of spreading branches. Its bark is gray and nearly smooth. The evergreen (rarely deciduous), alternate leaves are compound with 3 to 5 pairs of oblong, obovate-oblong, or elliptic leaflets, 6 to 12 inches (15-30 cm) long, rounded at the base, short-pointed at the apex; bright-green and glossy on the upper surface, dull and paler and finely hairy on the veins on the under side. Bisexual and male flowers, borne together in simple racemes 3 to 7 inches (7.5-17.5 cm) long, are fragrant, 5 petalled, white and hairy. The fruit is a leathery, pear shaped, more or less distinctly 3-lobed capsule 2 3/4 to 4 inches (7-10 cm) long; basically yellow, more or less flushed with bright-scarlet. When it is fully mature, it splits open revealing 3 cream-colored, fleshy, glossy arils, crisp, somewhat nutty-flavored, attached to the large, black, nearly round, smooth, hard, shining seeds-normally 3; often one or two may be aborted. The base of each aril is attached to the inside of the stem-end of the "jacket" by pink or orange-red membranes. **Origin and Distribution:** The akee is indigenous to the forests of the Ivory Coast and Gold Coast of West tropical Africa where it is little eaten but various parts have domestic uses. In Ghana, the fruiting tree is admired as an ornamental and is planted in villages and along streets for shade. Besides Jamaica, the akee was planted also in Trinidad and Haiti and some other islands of the West Indies and the Bahamas and apparently was carried by Jamaican slaves to Panama and the Atlantic Coast of Guatemala and Costa Rica. In 1900 it was outlawed in Trinidad after it had caused some fatalities. There are scattered trees in Surinam, Venezuela, Colombia, Ecuador and Brazil, quite a number maintained as curiosities in southern Florida; and some planted around Calcutta, India. The tree has been tried in the warm, moist climate of Guyana and Malaya but has never survived. At Lammao, in the Philippines, it first bore fruit in 1919. There are two bearing seasons: between January to March and June to August. The fruit turns red on reaching maturity and splits open with continued exposure to the sun. Traditionally it is at this time that the akeebes are harvested and the arils removed and cleaned in preparation for cooking. This delicacy is enjoyed by many at breakfast or as an entree. The canned product is exported to ethnic markets worldwide and continues to be enjoyed by both visitors to the island and Jamaicans residing overseas. In 1957 as much as 197,645 pounds of canned akee arils were shipped from Jamaica to the United States. It was also exported to England, mainly for the Jamaican population settled there. **Climate:** The akee tree is tropical to subtropical; flourishes from sea-level to an elevation of 3,000 feet (900 meters) in Jamaica. It does not bear fruit in Guatemala City; fruits heavily in southern Florida where young trees have been killed by winter cold but mature trees have escaped serious injury during brief periods of 26 Fahrenheit (-3.33 Centigrade). **Soil:** The tree does very well on oolitic limestone (ovoid or spherical crystalline deposits of calcium carbonate 0.5 to 1.0 millimeter in range) and on sand in southern Florida and the Bahamas, though it grows faster in more fertile soils. Propagation and Culture: Akeee trees are grown from seeds or by shield-budding, and show very little variation. In European greenhouses, cuttings of ripe shoots are rooted in sand and raised in a mixture of peat and loam. In warm climates, the tree grows fast and requires little cultural attention. **How the fruit is eaten:** The akee must be allowed to open fully or at least partly before it is detached from the tree. When it has "yawned", the seeds are discarded and the arils, while still fresh and firm, are best parboiled in salted water or milk and then lightly fried in butter. Then they are really delicious. The water or milk in which they are parboiled is discarded. The average Jamaican however consumes the "pot liquor" as well. When a death occurs, people generally don't reveal to the investigating agencies that they have consumed Akee, because of perceived legal connotations. They stop eating Akees, and send the produce to the market for sale. There is an appropriate calypso: "I took my akees to the Linstead market; not a body would buy. Everybody come feel 'um, feel 'um; not a body would buy!" In Jamaica, they are often cooked with codfish, onions and tomatoes. After parboiling, they are added to a stew of beef, salt-pork and scallions, thyme and other seasonings. Sometimes they are curried and eaten with rice. They are served, not only in the home, but also in hotel dining rooms and other restaurants. In Africa, they may be eaten raw or in soup, or after frying in oil. **Other Uses of the plant:** Fruit – in West Africa, the green fruits, which produce lather in water, are used for laudering. The akee rind contains saporin and may be used to poison fish so that they will be rendered easier to catch. The seeds, because of their oil content, and the jacket because of its potash content, are burned and the ashes used in making soap. Flowers In Cuba an extract of the flowers is appreciated as cologne. Bark – on the Gold Coast, a mixture of the pulverized bark and ground hot peppers is rubbed on the body as a stimulant. Wood – the sapwood (the younger softer living or physiologically active outer portion of wood and is more permeable, less durable, and usually lighter in color than the heartwood) is white or light greenish-brown. The heartwood (the older harder nonliving central wood of trees that is usually darker, denser, less permeable, and more durable than the surrounding sapwood) is reddish-brown, hard, coarse-grained, durable, immune to termites. It is used locally for construction and pilings and has been recommended for railway sleepers. It is also fashioned into oars, paddles and casks. **Medicinal**
Uses – in Brazil, repeated small doses of an aqueous extract of the seed has been administered to expel parasites. The treatment is followed by a saline or oily purgative. Cubans blend the ripe arils with sugar and cinnamon and give the mixture as a febrifuge (antipyretic) and as a treatment for dysentery. On the Ivory Coast, the bark is mixed with pungent spices in an ointment applied to relieve pain. The crushed new foliage is applied on the forehead to relieve severe headache. The leaves, crushed with salt, are poulticed on ulcers. The leaf juice is employed as eye drops in ophthalmia and conjunctivitis. In Colomb ia, the leaves and bark are considered stomachic (a stimulant or tonic for the stomach). Various preparations are made for treatment of epilepsy and yellow fever. Toxicity Consumers of the unripe fruit sometimes suffer from “Jamaican vomiting sickness syndrome” (JVS), a syndrome marked by severe vomiting (see signs and symptoms below). The toxicity of the akee was long misunderstood and believed to reside in the membranes attaching the arils to the jacket, or only in the overripe and decomposing arils. There have been intensive clinical and chemical studies of the akee and its effects since 1940, and it is now known that it is the unripe arils which contain the toxic chemicals responsible for JVS. These are L-alpha-amino methylene cyclopropionic acid and its gamma-glutamyl conjugate, formerly called Hypoglycin A and Hypoglycin B respectively. Levels of Hypoglycin A in the akee arils peak at maturity but rapidly diminish to non-detectable levels in the opened fruit making it safe for consumption. But even when fully ripe, the arils still possess 1/12 of the amount in the unripe fruit. The reduction in toxicity occurs because of the aril's exposure to light, which destroys the hypoglycins. Cooking however does not destroy the poison. Ingestion of cooked unripe arils, is hazardous. The seeds are always poisonous. They also contain the same toxic chemicals. If an akee seed is swallowed, sudden and violent vomiting occurs, followed by convulsions, coma and death. Because of its potential danger, the Jamaican government has banned the canning of akee for export. Hypoglycin A, is about two times more potent than Hypoglycin B.1 Hypoglycin A and B cause their toxicity by blocking long chain fatty acid metabolism and subsequent gluconeogenesis at the mitochondrial level. Hypoglycin A is metabolized to methylenecyclopropylacetic acid and then forms methylenecyclopropylacetly-Coenzyme A (MCPA-CoA). MCPA-CoA is a suicide inhibitor of beta-oxidation of fatty acids. Beta-oxidation of fatty acids normally requires transport of fatty acids into mitochondria via a carnitine-transporter. Once in mitochondria, fatty acids undergo beta-oxidation to generate NADH, FADH2, and acetyl-CoA that can be utilized for gluconeogenesis or in oxidative phosphorylation and Krebs cycle to generate ATP. When oxidation of these fatty acids is inhibited, hypoglycemia (due to impaired gluconeogenesis), microvesicular steatosis of the liver (due to accumulation of lipid vesicles in the hepatocytes), hyperammonemion (due to interference with urea cycle), and metabolic acidosis (due to interference with ATP production) ensue. Hypoglycemia can be very profound, to levels as low as 3 mg/dL. Hypoglycin may also cause vomiting and central nervous system depression in the absence of significant hypoglycemia. Hepatotoxicity similar to that of Reye’s Syndrome has been found at postmortem study. In this regard it is recognized that the nutritional status of the consumer is important since diagnosed patients generally show manifestations of chronic malnutrition and vitamin deficiency. Although JVS has resulted in some fatalities in the past with symptoms including vomiting and severe hypoglycemia, nowadays such incidences are rare with the increased awareness of the necessity for consuming only ripe, opened akees. In feeding experiments at the University of Miami by Dr. Edward Larson, it was found that rabbits were readily killed by the unripe arils; rats were resistant and had to be force fed to be fatally poisoned. It has been observed that squirrels will make holes in the unopened fruits on the tree to consume the unripe arils but they leave the seeds untouched. Squirrels are apparently unaffected by the unripe arils. While its popularity has never faltered, akee killed around five thousand Jamaicans between the years 1886 and 1950. Outbreaks of JVS reach epidemic proportions during periods when food is scarce and unripe akee fruits are available. Profound hypoglycemia is the disease's hallmark. Prior to widespread recognition of hypoglycemia in association with this illness, mortality approached 80%. Occasionally tourists experience illness after consuming akees served in Jamaican hotels. In Florida, poisoning occurs when properties change hands, and the new owners from different states are exposed to Akee, without them knowing its poisonous properties. A recent outbreak in Burkina Faso (West Africa) reportedly produced a substantial number of previously unexplained deaths in preschool children. Frequency of Poisoning in the U.S. True incidence is unknown. Akee fruit sales are illegal in the US; however, cases have been reported after consumption of fruit shipped illegally. Internationally, the true incidence is unknown but is believed to be under reported. In Jamaica, the majority of cases occur from January to March (74% of epidemics in Jamaica occur in the winter months). At this time 30 to 50% of the arils have small underdeveloped seeds. Such arils are more toxic. Incidence in Jamaica has been estimated to be 1 case per 100,000 persons per year. In West Africa, a recent epidemic that included 29 cases of fatal encephalopathy in children with akee fruit exposure demonstrated an age-specific (2-6 years) attack rate of 31-847 per population of 100,000. Mortality/Morbidity: Before hypoglycemia was commonly recognized as a component of the disease, mortality approached 80%. Morbidity and mortality are’ highest in poor and malnourished patients. Children are more likely than adults to suffer fatal complications of akee fruit ingestion. Age: severe poisoning is more common in the pediatric population. Signs and symptoms: Symptoms start from 6 to 48 hours after ingestion (usually 12 to 36 hours). These include vomiting, followed by a period of drowsiness or sleep. The period of drowsiness is again followed by vomiting accompanied by intense thirst. In acute cases, there may be muscular and nervous exhaustion, seizures, prostration, coma and death. Occasionally there are delirium, a rise in temperature, and loose bowels. There is an apparent depletion of liver glycogen. Because of hypoglycaemic effects, administration of sugar solutions have been found
helpful. Most cases occur in winter in Jamaica when 30% to 50% of the arils have small, underdeveloped seeds, often not apparent externally. Pregnancy - there is concern in Jamaica that ackee fruit ingestion may be associated with anencephaly, spina bifida, and hydrocephalus; however, teratogenic effects are not well established. **Medico-legal aspects:** It is quite easy for an unscrupulous person to administer this poison to an unsuspecting enemy. Probably this is the only poison, which is not only not bitter, but actually "nutty" in taste. Its taste thus is rather agreeable, and the enemy can not get suspicious. Very large quantities are not required to kill. Most reports indicate that people died after eating arils from just one fruit. Another advantage to the prospective poisoner is that the symptoms start quite late (almost 12 to 36 hours after ingestion), so the poisoner gets time to cover his tracks, and probably set up an alibi. **Forensic Autopsy:** A forensic autopsy should concentrate on the following points: (1) A death which has occurred following vomiting, intense thirst and drowsiness, should at once alert the pathologist towards Akee poisoning. There may be seizures as well. (2) A very low level of blood glucose. It could be as low as 3 mg%. (3) Serious depletion of liver glycogen. Liver glycogen must be done, as a serious depletion would go strongly in favour of akee poisoning. (4) Hepatotoxicity similar to that of **Reye's Syndrome** should be found. (5) **Hypoglycin A** and **Hypoglycin B** may be detected in the blood. (6) Remains of arils in stomach may or may not be found, as symptoms usually start between 12 to 36 hours after ingestion, by which time, stomach and probably intestines have emptied. **Appendix 1 Akee, Breadfruit Akee, and Breadfruit,** are commonly confused together, and some people believe that it was Akee, which actually started the mutiny on William Bligh's ship. This is not correct. It was the breadfruit, a completely different plant which started the mutiny. The confusion probably arose, because both Breadfruit (Artocarpus communis) and Akee (Blighia sapida), were made known to the world by William Bligh (born Sept. 9, 1754, County of Cornwall, England, and died Dec. 7, 1817, London). Breadfruit was native to Tahiti, from where it was taken by Bligh to West Indies in 1792 (an earlier attempt in 1787-1789 had resulted in the Mutiny). It was this tree which was seen as a source of cheap food to the slave labor working in tea and sugar plantations, as it contains a considerable amount of starch, and can actually be ground into flour. Akee on the other hand was native to West Africa, from where it was taken sometime in 18th Century to Jamaica, by unknown seafarers. Bligh took it from Jamaica to Kew, England, in 1793. No mutiny is associated with Akee. **Details of Mutiny:** Following are the dates which are associated with the famous mutiny on the ship *Bounty.* On the 23rd December 1787: *Bounty* sailed from Spithead 26th October 1788: Arrived in Tahiti (Pacific Ocean) 31st March 1789: Captain Bligh records in his logbook that plants had been loaded in the ship 4th April 1789: *Bounty* set sail for West Indies 28th April 1789: The crew mutinied (24 days later). The first returned to Tahiti, and then searched for some other place 14 June, 1789: In a remarkable feat of seamanship, Bligh eventually reached Timor in the East Indies on, after a voyage of about 3,600 miles (5,800 km) in the open longboat (He took only 1.5 months to reach there. And he reached a safe place 7 months earlier than the mutineers). 15 January 1790: Mutineers land in Pitcairn Island (some 1350 miles south-east of Tahiti) February 1792: Bligh was again in Tahiti, and this time succeeds in transporting breadfruit to West-Indies.

**References:**

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