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Views: Ergot and the Salem Witchcraft Affair: An outbreak of a type of food poisoning known as convulsive ergotism may have led to the 1692 accusations of witchcraft

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## Ergot and the Salem Witchcraft Affair

### Views

*An outbreak of a type of food poisoning known as convulsive ergotism may have led to the 1692 accusations of witchcraft*

The witchcraft affair of 1692 had several peculiar aspects. In terms of the number of people accused and executed, it was the worst outbreak of witch persecution in American history. Accusations of witchcraft were made not only in Salem Village (now Danvers) but also in Andover, Beverly, Boxford, Gloucester, Ipswich, Newbury, Topsfield, and Wenham, all in Massachusetts, and in Fairfield County, Connecticut. The timing of the outbreak was strange, since it occurred 47 years after the last epidemic of witch persecution in England. No one has been able to prove why it occurred in 1692, and not some other year, or why it happened in Essex County, Massachusetts, and Fairfield County, Connecticut, and not in other counties.

In 1976 psychologist Linnda Caporael proposed an interesting solution to the problem of why various physical and mental symptoms appeared only in certain communities at certain times (1). She suggested that those who displayed symptoms of "bewitchment" in 1692 were actually suffering from a disease known as convulsive ergotism. The main causal factor in this disease is a substance called ergot, the sclerotia of the fungus *Claviceps purpurea*, which usually grows on rye (Fig. 1). Ergot is more likely to occur on rye grown on low, moist, shaded land, especially if the land is newly culti-

vated. The development of ergot is favored by a severely cold winter followed by a cool, moist growing season: the cold winter weakens the rye plant, and the spring moisture promotes the growth of the fungus.

People develop ergotism after eating rye contaminated by ergot. Children and teenagers are more vulnerable to ergotism than adults because they ingest more food per unit of body weight; consequently, they may ingest more poison per unit of body weight. Made up of four groups of alkaloids, ergot produces a variety of symptoms. Diagnosis may be difficult because many symptoms are not present in all cases.

According to current medical thinking, the symptoms of early and mild convulsive ergotism are a slight giddiness, a feeling of frontal pressure in the head, fatigue, depression, nausea with or without vomiting, and pains in the limbs and lumbar region that make walking difficult (2). In more severe cases the symptoms are formication (a feeling that ants are crawling under the skin), coldness of the extremities, muscle twitching, and tonic spasms of the limbs, tongue, and facial muscles. Sometimes there is renal spasm and urine stoppage. In the most severe cases the patient has epileptiform convulsions and, between fits, a ravenous appetite. He may lie as if dead for six to eight hours and afterward suffer from anesthesia of the skin, paralysis of the lower limbs, jerking arms, delirium, and loss of speech. He may die on the third day after the onset of symptoms. Animals suffering from convulsive ergotism may behave wildly, make loud, distressed noises, stop lactating, and die.

Caporael matched the symptoms and their epidemiology in 1692 with those in the above model. She was severely criticized by psychologists

N. K. Spanos and Jack Gottlieb on the ground that the facts of the case fit the model very imperfectly (3). I have concluded, after examining the Salem court transcript, the ecological situation, and recent literature on ergotism, that this objection is not as valid as originally perceived.

Previous attempts to explain the witchcraft affair of 1692 have been unsatisfactory. The work of historians Paul Boyer and Stephen Nissenbaum, for example, has been concerned with the social reactions to the symptoms of bewitchment, rather than the origin of the symptoms (4). Other historians have attributed the outbreak to the tendency to make scapegoats of certain members of a community; although this is a widespread and chronic phenomenon, it is insufficient to explain the unique aspects of the case. New Englanders believed in witchcraft both before and after 1692, yet in no other year was there such severe persecution of witches.

The suggestion that the afflicted teenage girls in Salem Village were feigning their symptoms or, as Spanos and Gottlieb suggested, role-playing in the presence of social cues cannot explain the symptoms of the animal victims or of the other human victims who were apparently not stimulated by social cues. The suggestion made by an English professor, Chadwick Hansen, that the bewitched were suffering from hysteria is also unsatisfactory (5). People in the afflicted communities may have been hysterical in the sense that they were excited and anxious, but such psychological stimuli alone have not been shown to be capable of producing an epidemic of convulsions, hallucinations, and sensory disturbances in any case in which a diagnosis of ergotism or other food poisoning was seriously considered and then ruled out (6).

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**Figure 1.** The three ears of rye on the left of this early nineteenth-century drawing contain ergot, the sclerotia of the fungus *Claviceps purpurea*. Ergotism, a type of food poisoning caused by eating rye contaminated with ergot, produces a variety of symptoms similar to those commonly associated with bewitchment, such as pinching sensations and convulsions. The first two ears of rye contain a great number of ergots, more detailed examples of which are shown in the detached ergots on the drawing. The third ear, of stout rye, contains only one large ergot. The ear at the right, which also bears one ergot, is wheat, a grain rarely contaminated by the fungus. (From ref. 18.)

## Symptoms in 1692

In Essex County, Massachusetts, 24 of 30 victims of “bewitchment” in 1692 suffered from convulsions and the sensations of being pinched, pricked, or bitten. According to English folk tradition, these were the most common specific symptoms of a condition called “bewitchment” (7). Hence, they were the symptoms most often mentioned in the court records, for the intent of the court proceedings was to prove “witchcraft,” not to present a thorough medical case history.

Some of the other symptoms of “bewitchment” mentioned in the court record, like the most common symptoms, may also occur in cases of ergotism. These include temporary blindness, deafness, and speechlessness; burning sensations; seeing visions like a “ball of fire” or a “multitude in white glittering robes”; and the sensation of flying through the air “out of body.” Three

girls said they felt as if they were being torn to pieces and all their bones were being pulled out of joint. Some victims reported feeling “sick to the stomach” or “weak,” having half of the right hand and part of the face swollen and painful, being “lame,” or suffering from a temporary, painful urine stoppage. Three people and several cows died.

The Salem court record does not mention certain symptoms often associated with mild or early cases of ergotism, such as headache, nausea, diarrhea, dizziness, chills, sweating, livid or jaundiced skin, and the ravenous appetite likely to appear between fits. If these symptoms were present, they may not have been reported because they were not commonly associated with bewitchment. Nor does the court record establish whether or not the victims suffered relapses or how the cases ended.

Social cues in the courtroom may have stimulated some of the hallucinations, but such stimulation

does not disprove a diagnosis of ergotism. Ergot is the source of lysergic acid diethylamide (LSD), which some mycologists believe can occur in a natural state (8). People under the influence of this compound tend to be highly suggestible. They may see formed images—for instance, of people, animals, or religious scenes—whether their eyes are open or closed (9). These hallucinations can take place in the presence or absence of social cues.

Symptoms similar to those mentioned in the Salem court record also appeared between May and September of 1692 in Fairfield County, Connecticut. A 17-year-old girl, Catherine Branch, suffered from epileptiform fits, pinching and pricking sensations, hallucinations, and spells of laughing and crying. On 28 October she died, after accusing two women of bewitching her. John Barlow, aged 24, reported that he could not speak or sit up and that daylight seemed to prevail even at night. He had pain in his feet and legs (10). These symptoms also suggest a diagnosis of ergotism.

## Epidemiology

The victims of bewitchment in Essex County were mainly children and teenagers. Seven infants or young children are known to have developed symptoms or died. According to recent findings, nursing infants can develop ergotism from drinking their mother’s milk (2).

Spanos and Gottlieb, citing the court record, asserted that the proportion of children among the victims in 1692 was less than that in a typical ergotism epidemic. However, in a recent epidemic of ergotism in Ethiopia, the ages of the victims were not much different from those in the Essex County epidemic of 1692: more than 80% of the Ethiopian victims were aged 5–34 (11).

There can be no doubt that rye was cultivated in Salem Village and in many other parts of Essex County in the late seventeenth century (12). The animal cases could have resulted from ingestion of wild grasses such as wild rye or cord grass, some of which in Essex County were also liable to ergot infection (13).

The first symptoms of bewitchment appeared in Salem Village in December 1691. Beginning about 18 April 1692, the pace of accusation increased. It slowed in June and then

reached a peak between July and September. Exactly when the symptoms terminated is unknown. After 12 October 1692 there were no more trials for witchcraft, by order of the governor of Massachusetts. However, during the winter of 1692-93 in the area around Boston and Salem there were religious revivals, during which people saw visions (14).

If rye harvested in the summer of 1691 was responsible for the epidemic, why did no one exhibit any symptoms before December of that year? In the ergotism epidemics of continental Europe the first symptoms usually appeared in July or August, immediately after the rye harvest. But these episodes occurred in communities heavily dependent on rye as a staple crop and among people so poor that they had to begin eating the new rye crop immediately after the harvest. The situation was otherwise in New England. The diary of Zaccheus Collins, a resident of the Salem area during the epidemic, and probate inventories show that the rye crop often lay unthreshed in the barns until November or December if other food was abundant (15). Since ergot can remain chemically stable in storage for up to 18 months, stored rye might have been responsible for the symptoms of December 1691.

But if people normally delayed threshing rye until winter, why was there a peak of convulsive symptoms in the summer of 1692? Such a peak might be expected in time of food scarcity: was this the case in 1692?

Unfortunately the usual sources of information about food supply, government records, are missing for 1692, but data from tree rings indicate that in 1690, 1691, and 1692, the growing season in eastern New England was cooler than average. Diarists in Boston recorded that the winters of 1690-91 and 1691-92 were very cold (16). Since rye is a crop that flourishes in cold weather when other crops fail, people may have been more dependent on rye and therefore may have begun consuming it earlier in the year. In coastal areas, such as Essex and Fairfield counties, cool conditions are usually also moist; ergot grows more rapidly in moist weather.

In several other years for which tree rings indicate especially cool weather, there were epidemics of convulsions. The most widespread epidemic in New England occurred

in 1741. In 1795 a Salem epidemic, labeled "nervous fever," killed at least 33 persons (17).

The growth of population in Salem Village provided an incentive for local farmers to utilize their swampy, sandy, marginal land. This land, if drained, was better suited to the cultivation of rye than other cereal crops. But this was the very type of land in which rye was most likely to be infected with ergot (18). All 22 of the Salem households affected in 1692 were located on or at the edge of soils ideally suited to rye cultivation: moist, acid, sandy loams. Of the households, 16 were close to riverbanks or swamps and 15 were in areas shaded by adjacent hills. No part of Essex County is more than 129 m above sea level. As in Essex County, in southern Fairfield County, Connecticut, the predominant soil type was fine sandy loam, elevations were low, and the population was expanding (19).

Beginning in the 1590s, the common people of England began to eat wheat instead of rye bread. The settlers in New England also preferred wheat bread but, troubled by wheat rust, in the 1660s they began to substitute the planting of rye for wheat. This dietary shift may explain why the witchcraft affair of 1692 occurred 47 years after the last epidemic of witch persecution in England (20).

Although the limitations of surviving records make certainty impossible, the balance of the available evidence suggests that the witchcraft accusations of 1692 were prompted by an epidemic of ergotism. The witchcraft affair, therefore, may have been part of a largely unrecognized American health problem.

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