

Just Beneath the Surface: A Report on the Transdisciplinary Research at the Temple of Apollo at Delphi

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Abstract

Ancient sources describe the Oracles of Delphi entering altered states of consciousness associated with vapors rising from beneath the Temple of Apollo, accounts long dismissed by twentieth-century scholarship as myth or superstition. Recent transdisciplinary research has challenged this view, demonstrating that the temple was constructed above intersecting fault lines capable of channeling hydrocarbon gases, including ethylene, which can induce a trance-like state, into the adyton, where the Oracles sat. This paper examines geological, geochemical, medical, and archaeological evidence supporting this reassessment while also considering alternative explanations such as the ingestion of psychoactive substances, oxygen deprivation, mercury exposure, and toxic plant ingestion. Rather than advancing a single causal mechanism, this study argues that the Oracles' prophetic activity emerged from the interaction of environmental factors, ritual practice, and cultural influence. Scientific inquiry thus restores credibility to ancient testimony while revealing the limits of reductive explanations, highlighting the enduring wisdom of the Oracles of Delphi.

Keywords: Oracle, Delphi, Sybil, Pythia, divination, *adyton*, tripod, ethylene, psychoactive substances, cinnabar mercury poisoning erethism, *Nerium oleander*, bay laurel, cardiac glycosides, Mad Hatter's Disease, *antron*

Juste sous la surface : relation sur la recherche transdisciplinaire effectuée au Temple d'Apollon à Delphes

Résumé

Des sources antiques décrivent les Pythies de Delphes entrant dans des états de conscience particuliers, associés à des vapeurs s'élevant du sous-sol du temple d'Apollon. Ces récits furent longtemps considérés par la recherche scientifique du XXe siècle comme étant des mythes ou des superstitions. Cependant, des recherches transdisciplinaires récentes ont remis en cause ce point de vue, démontrant que le temple a été construit au-dessus de lignes de faille qui se croisent et qui pouvaient canaliser des gaz hydrocarbures, notamment de l'éthylène, capable de provoquer un état de transe, vers l'adyton, lieu où se tenaient les Pythies qui rendaient les oracles. Cet article examine les preuves géologiques, géochimiques, médicales et archéologiques qui étayent cette réévaluation, tout en prenant en compte des explications alternatives telles que l'ingestion de substances psychoactives, la privation d'oxygène, l'exposition au mercure et l'ingestion de plantes toxiques. Plutôt que de proposer un mécanisme causal unique, l'étude soutient que l'activité prophétique résultait de l'interaction entre des facteurs environnementaux, des pratiques rituelles et des influences culturelles. Notre recherche redonne ainsi de la crédibilité aux

témoignages anciens tout en révélant les limites des explications réductrices, et met ainsi en lumière la sagesse intemporelle des Oracles de Delphes.

Mots-clés : Oracle, Delphes, Sibylle, Pythie, divination, adyton, trépied, éthylène, substances psychoactives, empoisonnement au mercure (cinabre), érethisme, Nerium oleander, laurier, glycosides cardiaques, maladie du Chapelier fou, antron

Justo Bajo la Superficie: Un Informe sobre la Investigación Transdisciplinaria en el Templo de Apolo en Delfos

Resumen

Fuentes antiguas describen a los oráculos de Delfos entrando en estados alterados de conciencia asociados con vapores que brotaban bajo el Templo de Apolo; relatos que la comunidad académica del siglo XX descartó durante mucho tiempo como mito o superstición. Investigaciones transdisciplinarias recientes han cuestionado esta interpretación, demostrando que el templo fue construido sobre la intersección de fallas geológicas capaces de canalizar gases de hidrocarburos, incluyendo el etileno, que puede inducir un estado similar al trance, hacia el adyton, donde se sentaban los oráculos. Este trabajo examina evidencia geológica, geoquímica, médica y arqueológica que respalda esta reevaluación, considerando también explicaciones alternativas como la ingestión de sustancias psicoactivas, la privación de oxígeno, la exposición al mercurio y la ingestión de plantas tóxicas. En lugar de proponer un único mecanismo causal, este estudio argumenta que la actividad profética de los oráculos surgía de la interacción entre factores ambientales, práctica ritual e influencia cultural. De este modo, la investigación científica restituye credibilidad al testimonio antiguo, al mismo tiempo que revela los límites de las explicaciones reduccionistas, destacando la sabiduría perdurable de los oráculos de Delfos.

Palabras clave: Oráculo, Delfos, Sibila, Pitia, adivinación, adyton, trípode, etileno, sustancias psicoactivas, cinabrio, intoxicación por mercurio (eretismo), Nerium oleander, laurel, glucósidos cardíacos, enfermedad del Sombrero Loco, antron

Logo Abaixo da Superfície: Um Relatório sobre a Pesquisa Transdisciplinar no Templo de Apolo em Delfos

Resumo

Fontes antigas descrevem os Oráculos de Delfos entrando em estados alterados de consciência associados a vapores que emanavam das profundezas do Templo de Apolo — relatos há muito descartados pela comunidade científica do século XX como mito ou superstição. Pesquisas transdisciplinares recentes desafiaram essa visão, demonstrando que o templo foi construído sobre a interseção de falhas geológicas capazes de canalizar hidrocarbonetos gasosos, incluindo o etileno (que pode induzir um estado de transe), para o *adyton*, onde os Oráculos se sentavam. Este artigo examina evidências geológicas, geoquímicas, médicas e arqueológicas que sustentam essa reavaliação, ao mesmo tempo que considera explicações alternativas, tais como a ingestão de substâncias psicoativas, a privação de oxigênio, a exposição ao mercúrio e a ingestão de plantas tóxicas. Em vez de propor um único mecanismo causal, este estudo argumenta que a

atividade profética dos Oráculos emergiu da interação entre fatores ambientais, prática ritualística e influência cultural. A investigação científica, portanto, restaura a credibilidade do testemunho antigo enquanto revela os limites das explicações redutivas, destacando a sabedoria perene dos Oráculos de Delfos.

Palavras-chave: Oráculo, Delfos, Sibila, Pitonisa, divinação, *adyton*, trípode, etileno, substâncias psicoativas, cinábrio, envenenamento por mercúrio, eretismo, oleandro, loureiro, glicosídeos cardíacos, Doença do Chapeleiro Maluco, *antron*

Genau unter der Oberfläche: Darstellung der transdisziplinarischen Untersuchung über das Orakel von Delphi

Zusammenfassung

Antike Quellen deuten darauf hin, dass die Prophezeiungen von Delphi einem veränderten Bewusstseinszustand entsprangen. Ihrer Beschreibung zufolge könnten die Dämpfe im Untergrund des Tempels von Apollo womöglich eine effektive Rolle gespielt haben. Die Wissenschaftler des 20. Jahrhunderts haben dies lange als Mythos oder Aberglauben eingestuft. Rezente transdisziplinäre Untersuchungen haben diese Sichtweise jedoch infrage gestellt, denn es wurde nachgewiesen, dass der Tempel über überkreuzenden Verwerfungslinien, die Kohlenwasserstoffgase einschließlich Ethylen kanalisieren können, gebaut wurde. Letztere könnten zu Trance ähnlichen Zustände im Adytum, wo das Orakel saß, herbeigeführt haben. Dieser Aufsatz prüft geologische, geochemische, medizinische und archäologische Indizien, die diese Neubewertung unterstützen. Darüber hinaus werden alternative Auswertungen wie die Einnahme von psychoaktiven Stoffen, Sauerstoffentzug, Kontakt mit Quecksilber und giftige Pflanzen berücksichtigt. Diese Untersuchung argumentiert, dass die Orakel Prophezeiungen eher aus einem Zusammenspiel von Umweltfaktoren, rituellen Übungen und kulturellen Einflüssen stammen als von einem einzigen ursächlichen Vorgang. Insofern stellt die wissenschaftliche Untersuchung die Glaubwürdigkeit alter Aussagen wieder her wobei die Grenzen der reduktiven Erklärungen dargelegt werden und die nachhaltige Weisheit vom Orakel von Delphi hervorgehoben wird.

Schlüsselworte: Orakel, Delphi, Sybille, Pythia, Prophezeiung, Adyton, Dreifuß, Ethylen, psychoaktive Stoffe, Erethismus durch Quecksilbervergiftung mit Zinnober (Quecksilbersulfit), Nerium Oleander, Gewürzlorbeer, Herzglykoside, Hutmachersyndrom, Antron (Höhle)

Introduction

Just beneath the surface of everyday life lies something extraordinary, something magical. Perhaps nowhere has this been better demonstrated than in Delphi, home of the ancient Oracles—the women prophesiers, who were also called *Pythias* and *Sibyls*.

Ancient historians reported that gases, wafting from the floor of the Holy of Holies in the Temple of Apollo, coincided with the Oracles' extraordinary abilities to see beyond the usual limits of time and space; however, European researchers in the early 1900s disputed this ancient theory. During their excavations at the newly uncovered temple, they noticed no crevasses or fissures

through which such gases could have escaped, casting doubt on the source and even the existence of the Oracles' abilities. This theory dominated academia for almost one hundred years.

Then, in the last years of the twentieth century, serendipity brought together researchers from various fields to vindicate the ancient Sibyls. Their transdisciplinary research uncovered one of the most elusive secrets of the ancient world—one of the possible sources of the Oracles' ability to reach other states of consciousness. This synergistic collaboration between a geologist, archaeologist, geochemist, and health professional resulted in a convincing argument that overturned the prevailing theory that had misled and stifled researchers for almost a century. This paper also explores ideas put forward by geologists, medical professionals, and others involving psychoactive substances, oxygen deprivation, mercury toxicity, and oleander poisoning and supports the idea that the Oracles' abilities may have come from more than one source.

Who Were the Oracles at Delphi?

At least as far back as 1600 BCE, women in the area of Delphi demonstrated an uncommon ability to see beyond the usual limits of time and space. Later, the newer Olympian-based religion appropriated Delphi as an important center dedicated to their deity, Apollo. The Oracles then became priestesses who spoke on behalf of Apollo.

The term *Sybil* applies to any prophetess, and such women in the ancient world of Greece and later Rome were revered for their wisdom whether through visions or through divination, reading natural signs or objects, or offering advice. The term *Pythia* was derived from the earlier name for Delphi, *Pytho*, where Apollo, given the epithet *Pythios*, slew the mythical serpent Python, who guarded the Oracles. The serpent's name referred to the rotting corpse of the serpent that lay deep beneath the site where it was slain. The term itself referred to a foul aroma, supposedly coming from the dead serpent.

The ancient writer Plutarch, a Delphic priest, among others, wrote about the Oracles' prophetic sessions. He described gases wafting up from the floor of the Holy of Holies, the *adyton*, and a sweet smell that accompanied the Oracles' unique abilities.

De Boer and Hale (2025) speak of the Pythias' visions as less about the future and more about making "right choices":

where to locate a new colony, when to attack an enemy, how to lift a curse, whom to choose as leader, what offering to make to which god. No kingdom, city, or private person could afford to make critical decisions without consulting the Pythia. Thanks to her prestige, Delphi became the richest and most famous Hellenic sanctuary. The Greeks called it the *omphalos*, or "navel of the world."

During early excavations of the adyton, a stone block was discovered that had triangular holes (perhaps for the tripod upon which the Oracle sat) as well as a rectangular hole of about 10 cm and a shallow channel that "had deposits of travertine (a form of limestone laid down by mineral springs)" (Reed 2026). This block of limestone was discovered in a sunken inner chamber of the

Apollo temple and researchers speculate that “the trough carried away the waters of the Kassotis spring, and the funnel-shaped hole conducted the sacred vapors from beneath the adyton. If the original omphalos was hollow perhaps it stood on top of the opening and channeled the pneuma through an aperture at the top and into the nostrils of the oracle” (Reed 2026). See Figure 1.



Figure 1. The excavated limestone floor tile (here on its side) that was the likely place where the Oracle sat in the adyton or Holy of Holies (Reed 2026).

In “The Pythia at Delphi: A Cognitive Reconstruction of Oracular Possession” (2019) Quinton Deeley, a professional academic and clinician with an interdisciplinary career, said that our understanding of the experience of the Oracles has changed along with our understanding of religion and altered states of consciousness. He wrote:

The words of the Pythia [Oracle] have been variously considered as wild and incoherent, deliberately ambiguous, rendered in verse, or simple prose. They have been viewed as caused by ethylene intoxication from geological emissions, coached or at least interpreted by priests to further local interests, or as the inspired speech of a woman similar to other cases of mediumship or divinatory possession described by social anthropologists. (Deeley 2019, 226)

We know from ancient writers like Diodorus Siculus (first century BCE) that goat herders at Delphi noted that when their sheep approached “a chasm . . . known as the ‘forbidden’ sanctuary . . . and peered into it, they would leap about in an extraordinary fashion and utter a sound quite different” (Siculus 1952). Diodorus goes on to say that whenever people approached the chasm they would become “inspired,” give each other prophecies, but “many were leaping down into the chasm under the influence of their frenzy and all disappeared.” Diodorus thus claims that only one woman was given the role of Oracle and was safely installed on a “tripod.” See Figure 2 of John Collier’s painting (1891) of the Oracle seated on a tripod with fumes rising from a crack in the floor; she is holding a dish (perhaps of spring water, a sacred drink, or tea) in her right hand and a laurel branch in her left.



Figure 2. *Priestess of Delphi* (1891) by John Collier; a Sybil is seated upon a tripod or three-legged chair.

Plutarch also wrote that there were two types of responses that the Pythia would make—one more subdued, but at other times, more “frenzied.” After an intense episode an Oracle would die within a few days (Reed 2026).

This paper explores not only what was once thought about the probable causes of such responses, but also various more recent theories.

What Was Known Before?

Beginning in the late 1800s, French archaeologists excavated the temple area. Their reports stated that there was evidence of a spring, which, as Pausanias had suggested, rose up in the Holy

of Holes. However, they didn't notice any fissures, vaporous clefts, or a bottomless abyss. The official report stated, "Thus, on the level where the Western foundations were established, the ground is virgin, without the remains of pottery, without a trace of upheaval. There was never a crack in this part, much less an artificial or natural excavation."

Several scholars, venturing outside their fields of expertise, perpetuated this theory until the possibility that there was a physical source for the Oracles' abilities or that they even possessed such abilities was generally disregarded. In 1904 a young English scholar, Adolph Paul Oppé, published a paper entitled "The Chasm at Delphi." In it he stated that the foundations of the Temple showed no signs of an adyton or fissures, and there was no possible means for production of the fumes. He also claimed that no natural gas could create prophetic visions, and that the reports of Oracles undergoing violent and sometimes deadly reactions were not consistent. He went on to present his own geological guesswork (he was an historian, not a geologist) that was erroneous in almost every way.

In 1907, Frederick Poulsen, a Danish scholar specializing in classical art, wrote in his influential book *Delphi*: "The French excavations have not exposed any bottomless abyss from which strong and stupefying gases could be supposed to rise. One does well to reject the physical and hold fast to mental causes, hysterical affections, which in every religion make women serviceable media" (Poulsen 1920, 24).

However, later reviews of the evidence collected by the French have revealed that there was evidence contrary to their opinions at the time. In the book *The Oracle: Ancient Delphi and the Science Behind Its Lost Secrets* (2007), *New York Times* science journalist William J. Broad wrote that an image from the French expedition of the excavated interior shows small fissures through which gas could have escaped into the temple. Also, neither Oppé nor Poulsen considered that there may have been earthquakes that affected Delphi as a geological site. We now know that Delphi is seismically active and has had 144 earthquakes since the year 1900 with at least twenty-one over magnitude 6 and 123 between magnitude 5 and 6 (*Volcano Discovery* 2026).

Regardless, the renewed interest in Delphi and its priestesses that began in the 1800s subsided. The Oracles were officially certified as "hysterical" women and would lie voiceless again for nine more decades.

What Modern Researchers Discovered

The recent discoveries began with the work of Jelle Zeilinga de Boer, a geologist who grew up in seismically active Indonesia. In 1979, he was hired to assess the geology around Delphi. The Greek government was considering building nuclear power plants in the area to deal with their energy shortage and pollution problems. While exploring the area, de Boer saw a large fault running east-west through Delphi.

In 1995, he happened to meet John Hale, an archaeology professor at the University of Louisville. Hale was working on an archaeological site in Portugal and had some questions that required the expertise of a geologist. One of Hale's colleagues told him she knew of a geologist,

de Boer, who happened to be in Portugal at the time. The two met and eventually de Boer shared his experience of seeing the fault at Delphi. Hale told him this was impossible, as researchers had ruled out this possibility. Thus began their collaboration.

Hale began researching original texts from ancient writers such as Plutarch, Strabo, Homer, and Euripides. He found several important documents that proved to be especially helpful to de Boer's geological work. Hale wondered why this area in particular was so special, and how did it set the conditions for the unique abilities of the Oracles?



Figure 3. In this ancient image (ca. 400 BCE), the Oracle of Delphi sits on a three-legged chair, gazing into a bowl and holding leaves, with Aegeus, the mythical king who is associated with the founding of Athens, standing before her.

In the late 1990s, the team needed a geochemist to analyze rock samples they took from the adyton, with special permission from the Greek government. The travertine rocks, a natural stone made of calcium carbonate, may have trapped ancient gases inside them as they formed. They chose Jeffrey P. Chanton, a renowned geochemist and Distinguished Professor of Oceanography at Florida State University in Tallahassee. Chanton found ethane and methane in the rocks, but neither of these would have caused the behavior or abilities of the Oracle.

De Boer asked Chanton if he found any ethylene, a colorless, flammable hydrocarbon gas known to ease pain and induce euphoria and dreamlike states. Chanton reported that no ethylene had been found; however this did not surprise him since it was lighter and evaporated much more quickly than the other gases that had been found. He suggested that water samples be taken from nearby springs. (The main spring that ran through the Temple of Apollo had dried up centuries ago.) Ethylene would not disappear as quickly in the water samples.

Not only did the water samples contain ethylene, but Chanton found that the highest concentrations were in areas where two faults crossed. Now the researchers knew why this area in particular was so special. De Boer had previously discovered a second fault that intersects in Delphi, forming an X under the adyton in the Temple of Apollo.

In 2000, in their paper on the subject titled “The Geological Origins of the Oracle at Delphi, Greece,” De Boer and Hale explained in detail exactly what the French missed. In the abstract of the paper, they wrote:

A major WNW-ESE fault zone and a minor swarm of NNW-SSE fractures intersect below the site. These intersection(s) provided pathways for rising ground water, including a spring below the Apollo temple. The faults broke through a bituminous limestone formation at relatively shallow depth. Hydrocarbon gases that originated in this formation may have escaped during and after seismotectonic events. Such gases can induce mild narcotic effects. It is highly probable therefore that the Pythia’s inspiration resulted from the inhalation of light hydrocarbon gases, which rose along a fissure (fracture) in the adyton below the Apollo temple.

For a visualization of where the two fault lines intersect below the Temple of Apollo, please see Figure 4.

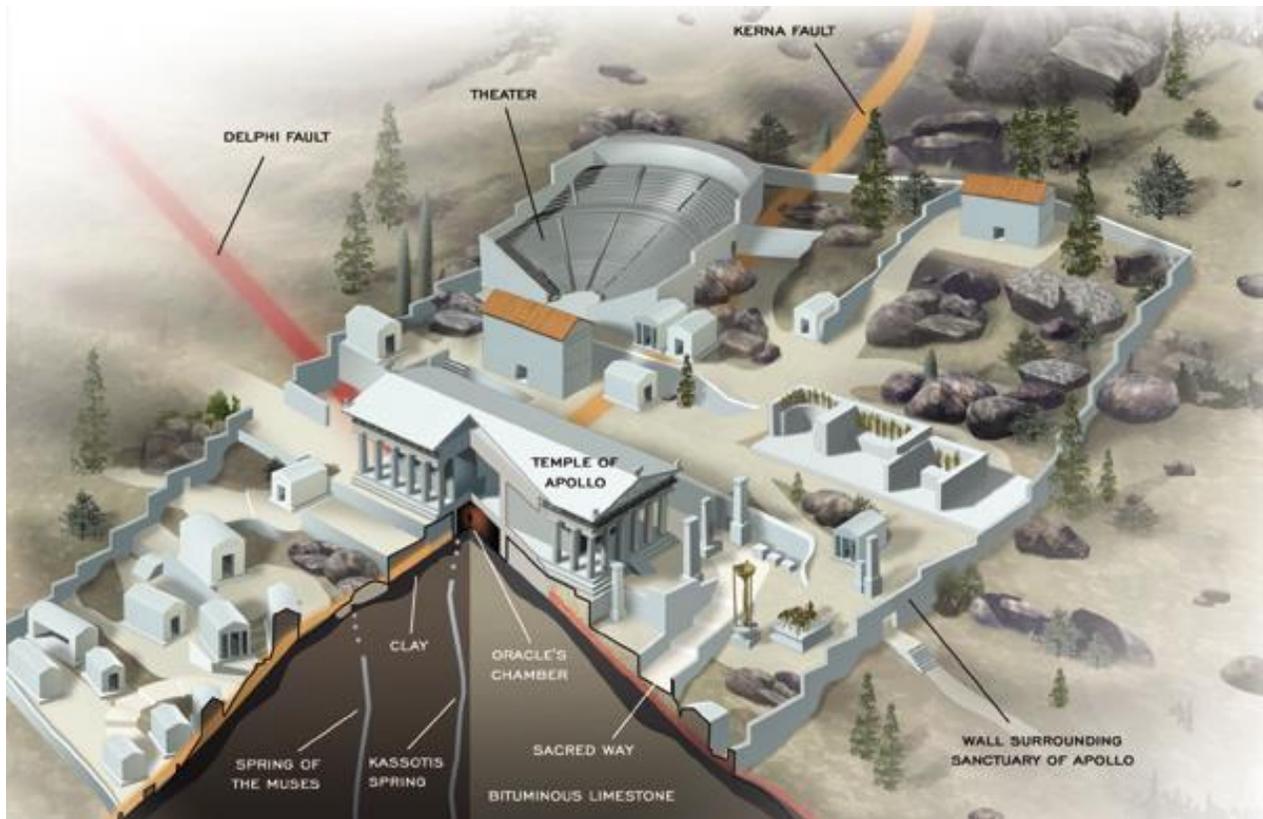


Figure 4. A reconstruction of the ancient site where the Oracle at Delphi's chamber lay beneath the Temple of Apollo showing both fault lines and sources of spring water. Image by Frank Ippolito (2025). Original image in "The Oracle of Delphi—Was She Really Stoned?" by de Boer and Hale 2002.

In 2000, a fourth collaborator was brought in to explore the effects of ethylene on human beings. Rick Spiller, a toxicologist, was the director of the Kentucky Regional Poison Center in Louisville. Hale called on Spiller to provide information on the effects of inhaling ethylene. Spiller researched the history of ethylene, a sweet-smelling gas that had been used as an anesthetic for many years. In 1882, William James, Harvard Professor and president of the Society for Psychical Research, wrote an essay on his experiments with ethylene. He stated, "The keynote of the experience is the tremendously exciting sense of an intense metaphysical illumination. Truth lies open to the view in depth beneath depth of almost blinding evidence. The mind sees all logical relations of being with an apparent subtlety and instantaneity to which its normal consciousness offers no parallel." In the 1970s, ethylene was replaced by less volatile anesthetic gases, as ethylene is highly explosive.

In their 2003 article on the subject in *Scientific American*, de Boer, Hale, Chanton, and Spiller wrote:

Spiller uncovered even more parallels in the reports of experiments on the anesthetic properties of ethylene carried out more than half a century ago by pioneering American anesthesiologist Isabella Herb. She had found that a 20 percent mixture of ethylene produced unconsciousness but that lower

concentrations induced a trance state. In most cases, the trance was benign: the patient remained conscious, was able to sit up and to respond to questions, experienced out-of-body feelings and euphoria, and had amnesia after being taken off the gas. But occasionally Herb would see violent reactions, the patient uttering wild, incoherent cries and thrashing about.

Spiller also led and even participated in an experiment in which he and two other subjects inhaled ethylene. This produced giddiness in all the subjects and an insensitivity to pain.

Alternate Theories

While the ethylene theory remains influential, several alternative explanations challenge its sufficiency.

Oxygen Depletion

An August 2024 posting by Interscan, a gas-detection company based in the United States, offers the following information regarding ethylene (C₂H₄) exposure: “Ethylene is generally considered to have low acute toxicity, but prolonged or high-level exposure can pose health risks, particularly in enclosed spaces where it can displace oxygen.” The ethylene gas theory has been challenged by researchers (Etiope et al. 2006) that claim oxygen depletion by other gases could have caused the Oracle’s trance-like state:

New surveys including gas flux from soil, gas in groundwater, and isotopic analyses of spring scales, provide the experimental confirmation of the gas release in the Delphi area. Presently, methane, ethane, and carbon dioxide are being released from a thermogenic (catagenetic) hydrocarbon-prone environment. This environment is not prone to biogenic production of ethylene in amounts inducing neurotoxic effects (hundreds or thousands of ppm). . . . If gas-linked neurotoxic effects upon Pythia need to be invoked, they should be sought in the possibility of oxygen depletion due to CO₂-CH₄ [carbon dioxide and methane] exhalation in the indoor temple. Alternatively, a plausible geological explanation behind the natural presence of sweet scents could be the occurrence of aromatic hydrocarbons, such as benzene, dissolved in the groundwater spring.

The Kastalian and Kassotis Springs

Although we cannot confirm if the Pythia of Delphi achieved their prophecies from inhaling fumes, we do know that these women were highly revered in the ancient world for their visionary declarations. We also know that lustration rites were part of the preparation of visitors and also of the Pythia at Delphi. Several sources cite the Kastalian Spring used for bathing by both the supplicants and the Pythia before any prophesy was given; regardless, we also know that the Pythia drank from a lower spring, the Kassotis, and it is now disputed whether the two streams were connected (Taylor 2024). Thus, it is possible that the Pythia drank from a spring that may have induced effects not shared by the supplicants. See also Figure 4 for the location of the Kassotis Spring.

Psychoactive Substances

In *The Immortality Key: The Secret History of the Religion with No Name* (2020), Brian Muraresku offers that the power of the Oracles could have come from ritualized altered states of consciousness induced by psychoactive substances. He writes that natural gases helped but they weren't the whole story. "Aside from ethylene, there's no ruling out 'barley meal' or 'laurel leaves' as additional tools for causing or enhancing the Pythias' altered state of consciousness. The plants were long associated with Delphi by Plutarch and Aeschylus" (B. Muraresku, 2020).

He then quotes Walter Burkert, from *Greek Religion* (1991):

After a bath in the Castalian spring and after the preliminary sacrifice of a goat, she enters the temple, which is fumigated with barley meal and laurel leaves on the ever-burning *hestia* [Greek for "hearth"], and descends into the adyton, the sunken area at the end of the temple interior. There is where the *Omphalos* [Greek for "navel," it was the rounded stone thought to be the center of the world, allowing direct communication with the gods] and where, over a round, well-like opening in the ground, the tripod cauldron is set up. . . . Seated over the chasm, enveloped by the rising vapours, and shaking a freshly cut bay [-laurel] branch, she falls into a trance.

Muraresku suggests the Delphic priestesses entered trance states by ingesting psychoactive compounds, possibly mixed into sacred drinks, similar to the Eleusinian *kykeon*, a secret mixture that caused psychotropic effects. These substances may have included ergot-derived alkaloids or other plant/fungal entheogens. In other words, ground grain that had been contaminated with the common fungus, ergot, could have composed part of this mixture. The Eleusinian ethnobotany of *kykeon* is explained as such by F. J. Carod-Artal, Professor of Neurology (2013):

The ergot fungus (*Claviceps purpurea*), parasitises cereals, gramineae, knotgrass (*Paspalum distichum*) and darnel (*Lolium temulentum*) in the Mediterranean region.... Ergot (a *Claviceps sclerotium*) contains a wide variety of pharmacologically active substances, including more than 40 ergot alkaloids. The most psychoactive alkaloids are hydrosoluble [dissolve in water or liquid], while the most toxic, such as ergotamine or ergotoxin, are not.

Oleander Poisoning

Several ancient accounts of the ritual used by the Oracle describe her chewing laurel leaves before giving her pronouncements. In a short review entitled "Toxic Fumes and Ancient Oracles" (2024), Roseanne Chambers, American geologist, geographer, and writer gives an alternative explanation to toxic fumes for the Pythia's behavior: oleander. She suggests that behaviors due to oleander poisoning can be "like those of epilepsy, hence the interpretation that the spirit of Apollo possessed the Pythia."

The bay-laurel was a plant sacred to Apollo and was frequently used in both Greek and Roman architecture as a decorative motif. Most persons would be familiar with Corinthian style columns whose stone leaves at the top resemble laurel leaves.

The bay-laurel and *Nerium oleander*, also called rose laurel, both grow in abundance in the Mediterranean region and are often mistaken for each other. The bay-laurel is an herb that can be eaten, while rose laurel (*Nerium oleander*) is highly toxic both to animals and humans. A toxicology case study from Italy (Mantelli et al. 2023) explains further:

Nerium oleander is a toxic plant containing cardiac glycosides [plant substances affecting heart rhythm] throughout all its parts, thereby posing severe health risks upon ingestion. The clinical manifestations of oleander poisoning closely resemble those of digoxin toxicity, encompassing a *spectrum* of gastrointestinal symptoms, neuropsychiatric disorders, and cardiac disturbances.

Several plants contain toxic levels of cardiac glycosides including foxglove and *Nerium oleander*. These compounds have medicinal use, but dosage is critical since overdose has fatal consequences (Fu, Wu, and Zhang 2019).

In 2014, the medical journal *Perspectives in Biology and Medicine* published a paper that argues that the Pythias' symptoms described by Plutarch and others could be the result of oleander poisoning. The paper's author, Haralampos Harissis writes: "could the 'spirit'—which in ancient Greek also means the 'gas fumes'—have been the smoke from burning oleander leaves? And could these oleander fumes have originated in a brazier located in an underground chamber (the *antron*) and have escaped through an opening in the temple's floor?" Harissis further explains that Strabo, an ancient geographer, referred to the smoke inhaled by the Oracle as coming from an *antron*, meaning "cave" or hidden chamber. This medical paper confirms that eating the leaves of rose laurel causes intestinal issues that can lead to death, but that poisoning can also occur from drinking water contaminated by the plant or tea made from its roots, leaves or flowers or further, by smoke inhaled by burning any parts of the plant.

Cinnabar and Mercury Poisoning

In "Toxic Fumes and Ancient Oracles" (2024), Roseanne Chambers describes how cinnabar (mercury sulfide HgS) was valued for its intense red color (later called vermilion) as a decorative pigment, but also for its medicinal and symbolic use from the Early Neolithic era through ancient times, particularly in Spain where it was mined, as well as in Greece and the ancient Roman world. This mineral can also be found, particularly at higher temperatures in hot springs. Although cinnabar has not been confirmed at Delphi in the work noted above by de Boer, Hale, and Chanton, we do know that it was highly traded and distributed in the ancient world.

In a paper titled "High Priestesses of Copper Age Spain," D. Weiss (2024) explains that archaeologists have discovered unusually high concentrations of cinnabar and thus mercury contamination in the graves of women of status in the Valencia region. Such status was determined by the number and type of artifacts interred with one such burial site in particular

whose remains have been dubbed the Ivory Lady. Other ancient grave sites in the Mediterranean region show significant use of cinnabar as a preservative.

Ephesus, in Turkey, was inhabited by the Greeks and then the Romans, and shows archaeological evidence of cinnabar as a pigment used in a variety of architectural structures and from Ephesus was distributed widely due to trading routes in the Mediterranean and Aegean Seas. Ancient texts reveal that cinnabar was mined at Ephesus in the Cilbian fields, especially during the Roman period (Alexandra Rodler-Rørbo et al. 2025) as well as “in the Colchide region (Black Sea)” in ancient Greece (Botticelli 2016). Figure 5 shows areas in the world where mercury and cinnabar, its mineral form, occur naturally.

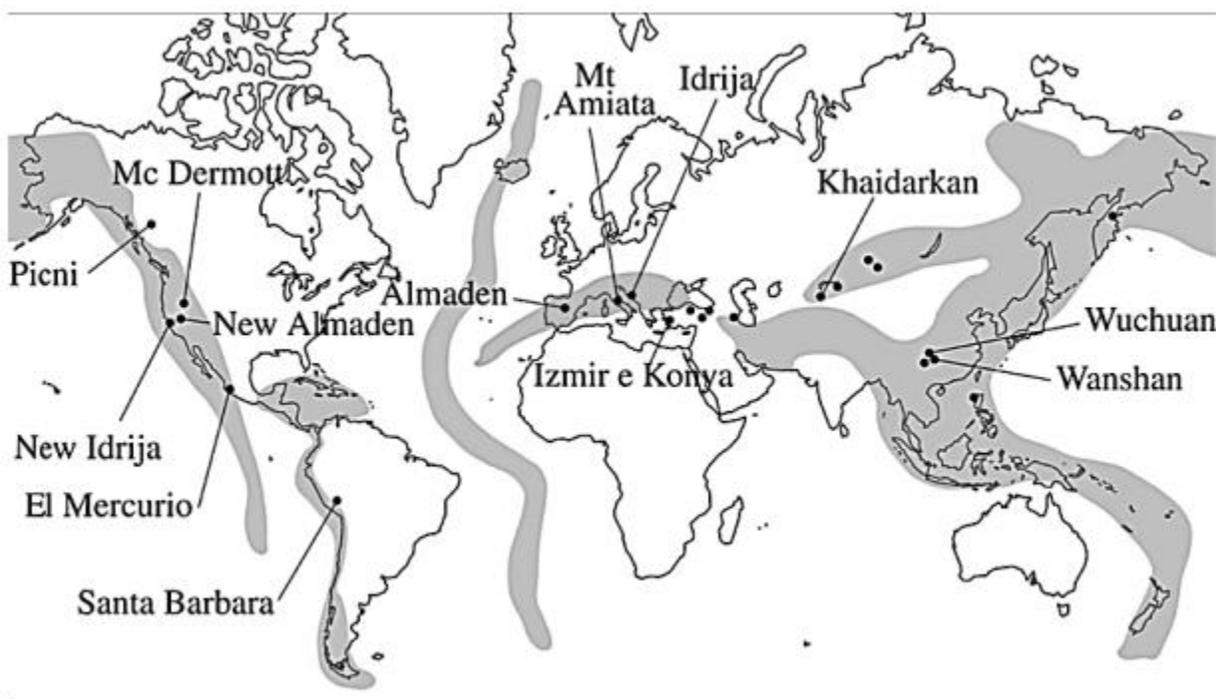


Figure 5. Mercury belts and cinnabar mines throughout the world. Map modified by Michela Botticelli (doctoral thesis 2016) from Pattelli et al., 2014.

It is interesting to note that what was termed “Mad Hatter’s Disease” in the early twentieth century is the result of chronic mercury poisoning. Hatters who worked in factories in the nineteenth century and even up to the 1940s developed neurological changes termed erethism due to the felting process in hat-making that involved mercury that could turn to vapor at room temperature (Zambon 2020). Some symptoms include hallucinations and psychosis or perceptions of an altered reality (Zambon 2020).

Mercury occurs naturally in several forms. A review of its forms and their toxicity by Robin A. Bernhoft (2012) states the following: “Inhaled elemental mercury vapor, for example, is easily absorbed through mucus membranes and the lung and rapidly oxidized to other forms (but not so quickly as to prevent considerable deposition of elemental mercury in the brain).” Bernhoft’s review goes on to state that mercury vapor poisoning creates “[c]hanges in coordination, tremor,

mental concentration capacity, facial expression, and emotional state.” Several, if not all, of these symptoms were described by Plutarch in his observations of the Pythia at work.

Conclusion

The transdisciplinary research examined in this paper demonstrates that modern science does not dismiss or “explain away” the power of the Oracles of Delphi—it restores credibility to ancient testimony while revealing the limits of any single explanatory framework. Geological fault lines, intoxicating gases, psychoactive substances, toxic plants, mineral contamination, ritual practices, and cultural authority may have all contributed to the conditions under which the Pythias’ altered states emerged. No one factor alone sufficiently explains the Oracles’ enduring influence; rather, it was the interaction of environment, body, belief, and social structure that sustained her power across centuries.

The rediscovery of Delphi’s geological complexity corrects nearly a century of scholarly dismissal rooted in disciplinary overreach and cultural bias. Early twentieth-century interpretations that reduced the Oracle to hysteria or fraud reveal more about their assumptions than about ancient religious experience. By contrast, contemporary interdisciplinary research affirms that ancient observers were often careful witnesses of natural phenomena, even when they described those phenomena in symbolic or religious language.

At the same time, scientific explanations—whether ethylene exposure, oxygen deprivation, mercury toxicity, or oleander poisoning—cannot fully account for the Oracles’ authority, insight, or cultural impact. Chemical stimulation alone does not explain how the Pythias shaped political decisions, liberated slaves, articulated moral guidance, or reflected the psychological and social tensions of the Greek world. These dimensions point to the Oracles’ role not merely as a biological subject, but as a cultural and religious institution embedded within a shared symbolic system.

Ultimately, this exploration invites a broader reconsideration of how knowledge is produced and validated. Rather than framing scientific inquiry and spiritual experience as opposing forces, the Oracles suggest that multiple ways of knowing can coexist—each illuminating different aspects of human experience. What lay “just beneath the surface” at Delphi was not only geological fissures or intoxicating vapors, but a complex convergence of nature, ritual, and meaning. Approached with humility, this convergence challenges modern assumptions about certainty and reminds us that the Oracles may still have much to teach us about the depths of human consciousness.

Conflict of Interest Statement

The author declares no conflict of interest.

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