

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/8450830>

Therapy with Saffron and the Goddess at Thera

Article in *Perspectives in Biology and Medicine* · February 2004

DOI: 10.1353/pbm.2004.0026 · Source: PubMed

CITATIONS

64

READS

2,411

2 authors, including:



[Susan C. Ferrence](#)

University of Pennsylvania

16 PUBLICATIONS 330 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Application of LIBS or PIXE to Minoan Pottery [View project](#)

THERAPY WITH SAFFRON AND THE GODDESS AT THERA

SUSAN C. FERRENCE* AND GORDON BENDERSKY†

ABSTRACT This paper presents a new interpretation of a unique Bronze Age (c. 3000–1100 BCE) Aegean wall painting in the building of Xeste 3 at Akrotiri, Thera. *Crocus cartwrightianus* and its active principle, saffron, are the primary subjects at Xeste 3. Several lines of evidence suggest that the meaning of these frescoes concerns saffron and healing: (1) the unusual degree of visual attention given to the crocus, including the variety of methods for display of the stigmas; (2) the painted depiction of the line of saffron production from plucking blooms to the collection of stigmas; and (3) the sheer number (ninety) of medical indications for which saffron has been used from the Bronze Age to the present. The Xeste 3 frescoes appear to portray a divinity of healing associated with her phytotherapy, saffron. Cultural and commercial interconnections between the Therans, the Aegean world, and their neighboring civilizations in the early 2nd millennium BCE indicate a close network of thematic exchange, but there is no evidence that Akrotiri borrowed any of these medicinal (or iconographic) representations. The complex production line, the monumental illustration of a goddess of medicine with her saffron attribute, and this earliest botanically accurate image of an herbal medication are all Theran innovations.

*Dawn in her saffron robe rose from the River of Ocean
to bring daylight to the immortals and to men.*

—Homer, *Iliad* 19.9

*Department of Art History, Temple University, Philadelphia.

†Department of History, University of Pennsylvania.

Correspondence: Gordon Bendersky, M.D., 623 Anthony Road, Elkins Park, PA 19027.

E-mail: sferrenc@temple.edu.

The authors are indebted to P. P. Betancourt for his valuable suggestions, sensitivity, and thoroughness in reading earlier drafts of this paper; his contributions provided significant clarification of the Aegean Bronze Age issues. The authors also wish to thank J. S. Adelman for her remarkable judgment in solving problems and formulating counterarguments, and N. Picardo and S. Budin for their critiques of other versions of the paper.

EIGHTY PERCENT OF THE WORLD'S POPULATION today relies almost exclusively on natural phytotherapy as a chief source of symptom prevention or disease treatment (Zava, Dollbaum, and Blen 1998). Through thousands of years of human experimentation, specific herbs have been recognized for treating a remarkable variety of symptoms as well as sex-related ailments. Frescoes at Akrotiri, Greece, suggest that the Therans of ancient Akrotiri developed saffron as a versatile medicine more than 3,600 years ago.

At approximately the mid-17th century BCE, the town of Akrotiri on the Greek island of Thera was destroyed by the devastating eruption of the island's volcano, which buried the two-, three-, and four-story buildings with all their contents under a vast layer of pumice and ash.¹ This prehistoric archaeological site resembles the much later Roman city of Pompeii in having very high levels of preservation resulting from the volcanic burial. Akrotiri lies on the southeastern coast of Thera (today also called Santorini), which itself is part of the Cycladic archipelago located north of the island of Crete in the Aegean Sea (Figure 1). Akrotiri's prosperity probably resulted from its trade network with other seafaring civilizations in the eastern Mediterranean, including dynastic Egypt (Doumas 1992, 17).

Spyridon Marinatos began excavating the town in 1967 under the auspices of the Archaeological Society of Athens, and the project has continued to this day under Christos Doumas, Marinatos' successor (Doumas 1992, 11; S. Marinatos 1968). These excavations have revealed that the inhabitants probably escaped with their lives, as no human bones have yet been discovered (Doumas 1983). Extremely well preserved wall paintings have been found throughout the town, and many frescoes that were found still adhering to the walls have been carefully cleaned, reassembled, and conserved. New discoveries are still coming to light. This essay is an attempt to reinterpret one of the first frescoes excavated at Akrotiri, in a building known as Xeste 3.²

¹The date for the Late Bronze Age eruption of the Theran volcano is a hotly debated topic among archaeologists and art historians. The high chronology is followed here. It places the beginning of the Aegean Late Bronze Age at c. 1700–1675 BCE, with the eruption at c. 1648 BCE, based upon various scientific analyses including dendrochronology and ice core correlations to Theran ash and pumice (Manning et al., 2002, 742). The low chronology dates the beginning of the Aegean Late Bronze to c. 1600–1580 BCE, based strictly upon artifactual synchronisms between the Bronze Age Aegean and contemporary cultures such as dynastic Egypt (Warren and Hankey 1989).

²There are two kinds of fresco: *buon fresco*, or “true fresco,” in which pigments are applied to the damp plaster surface resulting in a chemical bond at the molecular level as the painting dries; and *fresco secco*, or “dry fresco,” in which pigments are mixed with a bonding agent such as egg whites and then applied to the dry plaster surface. *Buon fresco*, which lasts significantly longer than *fresco secco*, was invented in the late 3rd millennium BCE on lime plaster in Crete and was almost unknown in the ancient Near East (Cameron 1978). Both *buon fresco* and *fresco secco* were used to create the paintings at Akrotiri (Doumas 1992, 18). The murals at Akrotiri were painted on lime plaster, which was applied over a mud and straw mixture affixed to the stone walls, and the pigments used were mostly made of mineral components: ferrous earths, hematite, yellow ocher, and copper oxide.



FIGURE 1

Map of the East Mediterranean with Akrotiri, Thera, in relation to other sites mentioned in the text.

Interpretation of the Akrotiri frescoes must be largely a matter of subjective reasoning. No documentation has yet been found in which Xeste 3 is described: the contemporaneous writings in the Minoan script called Linear A remain undeciphered, and no later Aegean texts refer to the frescoes. However, the Akrotiri frescoes and the Theran culture as a whole bear strong resemblances to the Minoan civilization on the island of Crete, most importantly exemplified at the site of Knossos. Many scholars have suggested varying degrees of cultural interaction to explain Akrotiri's similarities to Knossos ranging from governed colony to community colony to emulation of style (Branigan 1983, 49–53; Hood 1984, 33–37; Wiener 1990, 128–61).³ Thus, clues to the meaning of the Akrotiri frescoes are likely to be found through reference to Minoan culture.

³Wiener (1990) is often cited for his interpretation of this complex relationship, which he suggests reveals a kind of “Versailles effect.” He proposes that Minoan Knossos was central in the Aegean world at this time and that other towns, such as Miletos on the Anatolian coast, Trianda on Rhodes,

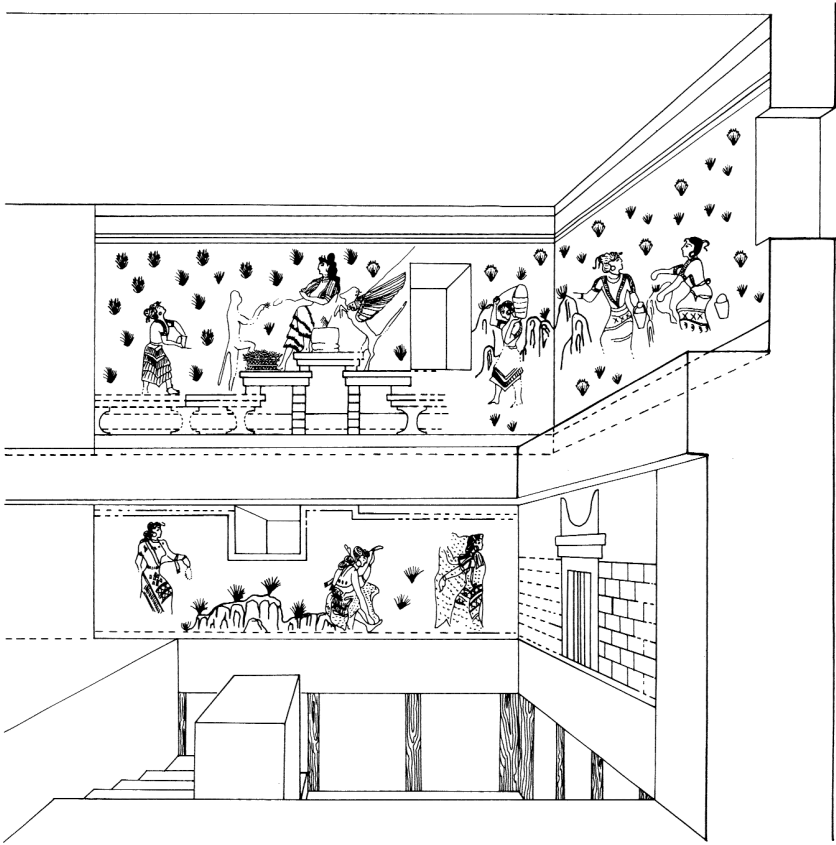


FIGURE 2

Reconstruction drawing of the Xeste 3 frescoes in relation to their floors and the recessed area below the lower floor level.

SOURCE: AFTER IMMERWAHR 1990, 60, FIGURE 20.

THE XESTE 3 FREScoes

The painting on the upper level of the building of Xeste 3 spans two adjacent walls and depicts an elevated central female figure, almost life-size, surrounded by animals and young girls in a crocus-filled landscape (Figures 2 and 3).⁴ This beautifully dressed and coifed woman is seated on a stack of cushions on a multicolored elevated tripartite platform. She wears many pieces of jewelry, including

Akrotiri on Thera, Phylakopi on Melos, and Ayia Irini on Kea, fell under the Minoan sphere of influence. In light of these theories and for the purposes of this article, we follow Wiener's considerations on the "Versailles effect" as it pertains to Knossos and Akrotiri.

⁴Excellent color plates clearly showing the details discussed in this paper can be found in Doumas 1992.

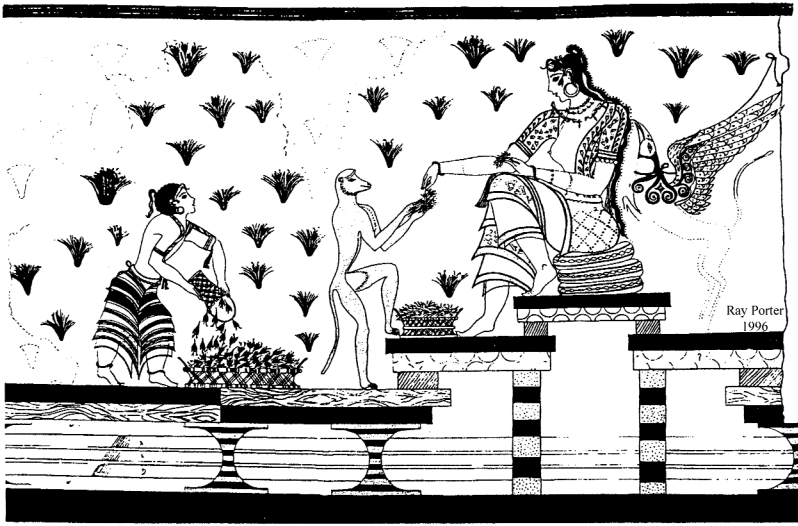


FIGURE 3

Reconstruction drawing of the segment of the Xeste 3 fresco, in which the monkey offers stigmas to the goddess.

SOURCE: AFTER PORTER 2000, 620, FIGURE 10.

necklaces of beads in the shape of waterfowl and dragonflies, and a bodice decorated with crocus flowers (Figure 4). To the right of the woman, a leashed griffin stands with its forepaws on the upper level of her platform, expands its decorative wings, and gazes up toward her head. On her left, a blue monkey steps up to the lower level of her platform while it extends a mass of crocus stigmas (taken from the basket in front of it) toward the woman, who reaches her right hand in the direction of the cluster. A young girl looks directly at the elevated woman as she empties crocus blooms from her small hand basket into a much larger basket on the ground to the left of the monkey. Another young girl to the right of the griffin strides toward the woman while she carries a hand basket on her shoulder. On an adjacent wall, two more young females converse with each other as they delicately pluck blooms from crocus clumps in an uneven rocky landscape.

Frescoes also extend across two contiguous walls on the lower floor of Xeste 3 (see lower level of Figure 2). These paintings are located directly above a small area below floor level with steps descending into this recess. On one wall, three female figures in a rocky landscape with crocus clumps face toward the adjoining wall, which depicts an architectural structure crowned by a set of Horns of Consecration streaked with blood or decorated with crocus stigmas. The figure on the left wears a diaphanous blouse ornamented with crocus flowers. She extends a necklace in her left hand as she walks in the direction of the architectural structure. The central figure is seated on a rocky outcrop with her left hand holding her head or adjusting the leafy spray in her hair as she reaches with her



FIGURE 4

Left: Detail of the goddess in the upper-level painting of Xeste 3. Right: Reconstruction drawing of the goddess grasping a cluster of saffron.

SOURCES: AFTER DOUMAS 1992, 162, FIGURE 125; PORTER 2000, 622, FIGURE 11.

right hand down toward her bleeding left foot. Two crocus stigmas are falling next to her foot. The younger female figure on the right is wrapping herself in a full-length veil as she steps away from the architectural structure, and turns her head backward to face it.

The frescoes of this building are among the best preserved and most debated paintings in all of Bronze Age Aegean art history. In these distinctive wall paintings, the artist has focused on isolating the female reproductive part of the crocus flower—the stigma—in elaborate detail. Scholars have interpreted these frescoes as representing various activities including fertility rituals, initiation and/or marriage ceremonies, autumnal rebirth, and local industry.⁵ Many archaeologists also

⁵Doumas (1992) suggests that the upper scene shows that the economic activity of gathering crocuses possibly results in the offering of stigmas to a Nature Goddess. According to Doumas, the lower level depicts an initiation ritual in which female adorants are associated with an altar/shrine topped by bloody sacred horns. S. Marinatos (1976) thought the primary female figure might also be the Great Goddess or the “Mistress of Animals” (*Potnia Theron*). N. Marinatos and R. Hägg (1986) indicate that the crocuses in the upper story could be connected to the initiation scene on the lower floor, with each girl representing a stage in the crocus picking process, which yields saffron for use as a drug, flavoring, or dye. Marinatos (1984a) emphasizes saffron’s importance, noting that it requires 60,000 stigmas to make one pound of saffron; saffron was an extremely valuable commodity, used especially as a medicine for anxiety, menstrual cramps, labor pains, and uterine hemorrhages. Porter (2000) believes the frescoes depict the peak blooming season for crocuses in the Aegean, and he feels the crocus must be a symbol of the goddess’ autumn rebirth. Gesell (2000) regards saffron as an economically important crop worthy of presentation to the goddess, suggesting that the Therans propitiated her for abundant fertility. Gesell also associates the stigma—as the female organ of the flower—with a female puberty or marriage ritual, possibly depicted in the



FIGURE 5

Author's rendering of C. cartwrightianus as depicted in Figure 4.

regard the Xeste 3 building as a cult center because of the identification of the beautifully dressed seated woman on the upper level as a goddess.⁶ However, most researchers agree that crocuses and saffron are at the heart of the matter. An examination of data from the different perspectives of mythology and science, along with the utilization of cultural, biological, and chemical analogies, may yield new insights into the meaning of these paintings. We propose that the program of Xeste 3 does not merely include the secondary medicinal value of saffron as a secondary element, but, in fact, emphasizes its primary therapeutic function, and exhibits the production sequence in cultic recognition of its precious curative value.

Crocus Botany

The Xeste 3 frescoes depict the Aegean *Crocus cartwrightianus* (Figure 5), an autumn-blooming flower with three large crimson stigmas that can be picked,

lower fresco. Davis (1986) feels the lower scene symbolizes the loss of virginity, with the wounded girl representing the loss of hymenal blood and the startled veiled girl symbolizes the loss of innocence, and proposes that the scene possibly depicts a prenuptial initiation rite, a marriage rite, or even consummation of a marriage. In contrast, Morgan (1990) believes the scenes focus on the economic activity of dying cloth yellow with saffron, and the presentation of stigmas to the goddess symbolizes Theran prosperity. Similarly, Sarpaki (2000) interprets the crocus gathering scene strictly as a female-dominated economic and social activity, and she completely divests the fresco of any religious meaning. Koehl (2001), on the other hand, interprets the lower level of paintings not as an initiation rite, but a re-enactment of the *hieros gamos* or sacred marriage; he suggests the wounded girl in the center is the bride and the standing youth holding a cloth on the wall in the adjoining room is her younger consort.

⁶A deity is usually recognized by his or her larger scale in comparison to other human figures, by his or her elevated position, and by the nature of accompanying figures or objects. Analogous representations from the Near East (where explanatory texts survive) are considered divine because they indicate enthroned figures receiving gifts and attended by mythological animals.

dried, and ground to make saffron (Porter 2000, 614; Sarpaki 2000, 661). The exceptional rendition of the crocus clumps in the paintings suggests that the ancient Therans may have had an intimate knowledge of the crocus plant. The remains of organic paint on the frescoes give a generally mauvish color for the crocus petals, which is within the range of pale to deep lilac purple for *C. cartwrightianus* (Porter 2000, 616). The clumps of crocus blooms in Xeste 3 are rendered quite naturally in comparison to other Aegean paintings illustrating crocuses: they are randomly spaced in the rocky landscape around the goddess, while the flowers and buds are taller than most of the leaves, as in nature (Porter 2000, 617).

Other Crocus- and Saffron-Related Frescoes in the Minoan Culture

Thera and Crete had a close trade and cultural exchange in the Late Bronze Age, and they shared many artistic similarities, including the depiction of crocuses in wall paintings. The Palace of Minos and its surrounding town of Knossos in north central Crete housed some of the most beautiful frescoes of the Minoan era. One of the rooms in the House of the Frescoes, northwest of the palace, was decorated with the Blue Monkey Fresco, also known as the Saffron-Gatherer Fresco (Immerwahr 1990, plates 10 and 11). This painting depicts a blue monkey wearing a red harness (perhaps a palatial pet or an attendant to a goddess like the monkey of Xeste 3 at Thera?) in a field of saffron crocuses surrounded by a rocky landscape on a red background. The monkey is plucking the crocuses and placing them into vases.

The Minoan villa of Hagia Triadha in south central Crete also had affinities with Knossos and Akrotiri. The villa housed three fresco panels in Room 14 (Immerwahr 1990, 101–2, 109, plate 18; Kontorli-Papadopoulou 1996, plate 52). One of these fresco panels depicts a kneeling female figure picking crocuses.

Significance of the Xeste 3 Frescoes: The Hypothesis

Crocuses—the primary plants depicted in the Xeste 3 frescoes—and women seem to be the governing factors in these wall paintings, and they are linked by the healing qualities inherent in the saffron. Of the numerous plant medicinals developed in the ancient Near East and East Mediterranean, saffron has had the largest number of applications over almost 4 millennia, with the widest geographic distribution as well as continuous and safe therapeutic application down to the present. Its safety, availability, effectiveness for a large variety of symptoms, and long pedigree of experience may explain why saffron is portrayed so prominently in Xeste 3. Another factor may be a belief in saffron's divine provenance. The depiction of the goddess in Xeste 3, with the griffin in attendance while a blue monkey delivers the crocus stigmas, is like no other scene in ancient art.

We hypothesize that the frescoes express a divinely encouraged concept: the medicinal healing that is the major function of the crocus/saffron. This hypothesis is based on three observations: (1) that the crocus and its stigma are the dom-

inant motif at Xeste 3; (2) that the medicinal phytoactivity in crocuses is concentrated in the stigma; and (3) that the proximity of the basket of saffron to the goddess, as well as the saffron cluster grasped in her hand, demonstrate the importance of this treasured product. As a corollary, the fresco may promote the belief that the goddess has bestowed curative power upon the saffron or has given humans the gift of saffron. This suggests another hypothesis: that the introduction of stigmas as medicine may have originated at Akrotiri, rather than being derived from a foreign template, although the concept may have received some inspiration from Crete.

THE HISTORY OF SAFFRON AND ITS THERAPEUTIC USE

Herbal medicinal products have been widely used since time immemorial, and specific plant remedies eventually became described in ancient written pharmacopoeias. These texts frequently imply an earlier empirical and/or magical application of particular herbal therapeutic materials. The oldest known pharmacopoeia is a Sumerian medical tablet from the 3rd millennium BCE that contains 15 prescriptions (Kramer 1963, 93–97). Although the tablet includes fermented “pine” tree, plum tree, powdered fir, undistilled resinous turpentine, thyme, mustard, and willow, the medical use of saffron is not mentioned.

The first mention of saffron—*azupiranu* (saffron) from *C. sativus* (*azupiru*)—appears in an Assyrian dictionary of botany written during the reign of Ashurbanipal (668–633 BCE) (Pritchard 1969, 294; Thompson 1949, 66, 157–63). It was used as an aid in dyspnea, painful urination, childbirth, menstrual disorders, and “diseases of the head” (Thompson 1908, 1924). This Assyrian text follows a tradition of plant therapy dating to Old Babylonian originals more than a millennium prior to Ashurbanipal (Oppenheim 1977, 289–91), and it thus places the medicinal use of saffron in the 17th century BCE or earlier.

Subsequent to the Bronze Age, saffron continued to be used in medicine for three millennia (until the modern era) over a wide geographic area for many and varied indications. In addition to those mentioned above, it was also used for such ills as cutaneous ulcers, wounds, acute diseases, infant thrush, palpitations, abortion, contraception, smallpox, measles, jaundice, and constipation (see Tables 1 and 2). Saffron was among the 257 drugs in the *Hippocratic Corpus* from the 5th to 4th centuries BCE, and it was used topically for purulent eye infections, watery and violently painful eyes, pains elsewhere, skin ulcers, and open wounds, and as a styptic; saffron also orally ameliorated acute diseases (Adams 1939, 99; Hirschberg 1982, 221–22; Jones et al. 1923–31, 2:317, 4:119, 8:325–27, 357). The reference to “wounds” is immediately pertinent to the fresco at Thera: the lower register of the wall painting (Figure 3) depicts a young woman possibly applying crocus stigmas to the injured and bleeding great toe of her left foot. In c. 300 BCE, Erasistratus suggested saffron could be used locally for throat inflammation, earache, and ulcers of the mouth and genitalia (Hirschberg 1982, 322). In

TABLE 1 LEADING EXAMPLES OF THE USE OF SAFFRON AS A FOLK MEDICINE

soporific	treat superficial wounds
contraceptive	dyspnea (as in asthma)
aphrodisiac	eye infections
abortifacient	sore throat
induction of labor	ear ache
promotion of lactation	abdominal pain
enhance fertility	dysmenorrhea
sedative	hangover
antiemetic	migraine
eye wash	fever
expectorant	constipation
antidepressant	chronic uterine hemorrhage

TABLE 2 PHARMACOLOGICALLY TESTED (1980–2002) AND FEASIBLE USES OF SAFFRON

<i>Used as</i>	<i>To treat</i>
analgesic	premenstrual syndrome
antiatherosclerotic	asthma
antihypertensive	hypercholesterolemia
antineoplastic	chronic uterine hemorrhage
antioxidant	dysmenorrhea

the 4th and 3rd centuries BCE, Herophilus of Alexandria prescribed saffron with opium orally for hemoptysis and topical saffron for diseases of the anus (von Staden 1989, 423).

In the first century CE, the *Materia Medica* of Dioscorides includes saffron for local application to the eyes (corneal disease and cataracts) and ears, topical treatment of erysipelas, and otherwise as a soothing ointment (Gunther 1934, 22–23; Hirschberg 1982, 190, 194; Manniche 1989, 50–51; Riddle 1985, 62, 66–67). Saffron was also taken orally as an aphrodisiac; Dioscorides stipulates that 12 grams or more can cause death (Riddle 1985, 62, 66–67).

Many other authors from antiquity, including Pliny, Galen, and Oribasios, continued to utilize the previous prescriptions in new compilations. The ancient Romans delayed intoxication by wine with the use of saffron (Toussaint-Samat 1992, 519–20). In the 1st century CE, the physician Scribonius Largus prescribed

saffron for acute and chronic eye inflammations (Hirschberg 1982, 258–59). Pliny the Elder (23–79 CE) refers to an eyewash (collyrium) containing saffron for blurred vision and excess tears; he also mentions the use of saffron for cataracts, throat ulcers, bladder inflammation, cough, pleurisy, pruritus, erysipelas, to induce sleep, restore hair growth, and postpone intoxication by wine (Jones 1951, 6:261–63; Nielson 1974, 10). The 2nd-century physician Soranus used saffron for infant thrush and obstetrical indications (Temkin 1956). Also in the 2nd century, Celsus' *De re medicina* claims effective treatment with saffron for blepharitis, proptosis, purulent infection and ulceration of the eyes, scabies, and wound cleaning (Page 1935). From the 2nd to the 5th centuries, Galen, Oribasius, and Marcellus Empiricus employed topical saffron for similar ophthalmic conditions (Nielson 1974, 12–16).

In c. 400 CE and continuing in practice to the early 20th century, the Tibetan book of *Four Treatises* (originally a Sanskrit medical text) treated liver and pulmonary diseases, joint pains, nervousness, diarrhea, indigestion, and menorrhagia with saffron (Rinpoche and Kunzang 1973). In the 6th century, the Greek physician, Aetius, prescribed a saffron collyrium for cataracts and poor vision (Nielson 1974, 15). The 7th-century text, *Fundamentals of Medicine* by Paulus of Aegina, contains a prescription of a saffron-containing collyrium for conjunctivitis and corneal ulcers, corneal pus, deep injuries to the eye, lid swelling, and abscess adjacent to the eye (Hirschberg 1982).

Written in the 8th century, the *Syriac Book of Medicines* (partially based on Hippocrates and Galen) describes the use of crocus and saffron for palpitations, abortion, contraception, “throbbing migraine” (hemicranial) headaches, delirium, eye and torso pain, earaches, abscess within the ear, throat abscess, hoarseness, dyspnea, diarrhea, hemoptysis, vomiting, anal ulcers, and dog bite (Budge 1976; Riddle 1992, 104–5). From the 9th to the 11th centuries, Arabic indications for saffron in Baghdad included eye conditions, gingivitis, canker, stomatitis, and sore throat (Levey 1966).

In the 12th century CE, saffron was developed for abdominal pain or to “settle the stomach” as an appetite suppressant (Basker and Negbi 1983; Toussaint-Samat 1992, 519–20). In the 13th century, Roger Bacon claimed that it delayed aging (Toussaint-Samat 1992, 519–20). In the later Middle Ages, it was used as an eye wash, to induce labor and abortion, to ameliorate jaundice, and to prevent vomiting (Nixon 1909, 35–39; Rowland 1981).

The English herbalist and surgeon John Gerard (1545–1612) recorded saffron's ability to cause euphoria or act as an antidepressant, to induce alertness (“Shaking off a heavey sleep”), and to relieve smallpox, measles, jaundice, constipation, dyspnea, pain, ergotism (St. Anthony's fire), and pestilence, as well as its efficacy as a diuretic (Johnson 1975, 153–54; Nixon 1909, 35–39). However, a recent text, *Narcotic Plants*, states that among the ancients, saffron was used not for alertness but to induce sleep (Emboden 1972). In the 17th century, it was used as an appetite stimulant, and in the 18th it was applied topically for eye inflammation and orally

to quell vomiting (Basker and Negbi 1983; Estes and Kuhnke 1984, 123, 151). In colonial America, saffron was consumed for dyspnea, asthmatic wheezing, pain, palpitations, fainting, jaundice, and melancholia (Weaver 2001, 270).

In the early 20th century, death occurred when saffron was utilized as an abortifacient (Basker and Negbi 1983). The toxic symptoms are severe gastric pain, blood-stained vomit and diarrhea, hematuria, vertigo, severe metrorrhagia, bradycardia and tachycardia, convulsions, and coma (Arena 1973, 463; Blacow 1972). The lethal dosage of saffron is approximately 12 to 20 grams, while the abortifacient dosage is approximately 10 grams (Walsh 2000, 654). During the mid-20th century, saffron was used for fever, melancholia, hepatomegaly, diabetes, splenomegaly, asthma, hemorrhoids (topically), bruises (topically), and to induce abortions as well as prevent miscarriages. It also remedied venereal condylomata, common warts, colds, snake-bites, cholera, hematomas, convulsions, a large variety of cancers, headaches, hangovers, dysmenorrhea, and to induce uterine contractions for early labor (Basker and Negbi 1983; Duke 2001, 148–49; Rios et al. 1996; Tang and Eisenbrand 1992, 187, 395–97). Both the Chinese and Indian pharmacopoeias officially list saffron, and in India it is considered “a fine aphrodisiac,” diuretic, and effective in rheumatism and neuralgia (Lewis and Elvin-Lewis 1977, 329; Nadkarni 1976, 310–11; Tang and Eisenbrand 1992, 187, 395–97). Among the North African Arabs and Berbers, saffron is used to ease pertussis, asthma, and hysteria, and to induce sleep (Boulos 1983, 97). Occasionally over the past two millennia, saffron has been prescribed as an emmenagogue (a drug promoting menses), but it is difficult to make a distinction between emmenagogues and abortifacients; remedies to provoke menstruation probably were intended to abort or to prevent conception.

In the late 20th and early 21st centuries, saffron or its derivatives, such as crocin and crocetin, have been found to exhibit *in vitro* and *in vivo* anti-tumor activity for different malignancies in humans and other animals and to prevent chemical carcinogenesis (Duke 2001, 148–49; Molnar et al. 2000; Rios et al. 1996). It improved ethanol-induced memory and learning impairments, as well as alleviated gingival pain, back pain, asthma, premature ejaculation, antibacterial and antiviral actions, oxygenating capacities, and dental analgesic benefits (Kazuho and Hiroshi 2000; Rios et al. 1996; Seyde et al. 1986; Zarghami and Heinz 1971). It acted as an antioxidant and a free-radical scavenger, and it reduced atherosclerosis progression (by virtue of the flavonoid, quercetin, contained in the crocus flower) (Hayek et al. 1997; Kazuho and Hiroshi 2000; Wiseman et al. 1997). Crocetin acted as a chemopreventive drug in acute hepatic damage, and it also lowered cholesterol levels, controlled hangovers and migraines, and alleviated measles, chronic uterine hemorrhage, diarrhea and nasal polyps (Chau-jong, Song-Jui, and Jen-Kun 1991). Saffron was also effective in lowering blood pressure and remedying both hemoptysis and pertussis (Leung 1980). Moreover, the Japanese have demonstrated the *in vitro* suppression of neuronal cell death, concluding that crocin should be included in studies regard-

ing the prevention or treatment of degenerative brain disease (Soeda et al. 2001). To this day, saffron is used medicinally in the Aegean for menstrual ailments (Barber 1992; N. Marinatos 1984b). Forsyth (2000) has detailed numerous ophthalmologic indications for the prescription of saffron, demonstrating saffron's efficacy in treating a range of eye diseases. However, she is mistaken when she states "that saffron is rarely included in non-ocular remedies (only 4.5%)" (163). At least 80% of the conditions for which saffron has been used are non-ocular.⁷

Saffron has been used both in ethnomedicine and in experimental studies for treatment of 90 distinct medical indications. Among this group, there are at least 20 individual symptoms or diseases with a demonstrable biochemical, pharmacological, or physiological basis for saffron's effectiveness. Unfortunately, randomized controlled clinical trials have not been performed to corroborate saffron's efficacy. Only in the last few decades have phytochemical studies and experimental evidence confirmed the potential success of some of the above saffron therapy. Otherwise, for the more than 30 centuries of herbal therapy with this substance, the rationale for the reported effectiveness of saffron or the crocus flower in many of the non-gender-related conditions was founded in what would now (in modern efforts subjectively and retrospectively) be called the undeveloped techniques of folkloric belief, accidental discovery, quasi-empirical trial, and placebo effect.

Placebos have been reported to be subjectively and objectively effective in up to 30 to 40% of patients with anxiety, palpitations, pruritus, pain, and asthma, etc. (Beecher 1955). Therefore, these ailments and some other targets for saffron therapy would have been expected to improve merely by the authority of the healer. The mechanism of this occult treatment may be simple imagination, "sympathetic magic," or some form of unintended hypnosis. It has already been suggested that the Bronze Age Aegean peoples would most likely have conflated ideas of magic, religion, and medicine in their day-to-day lives (Arnott 1999, 1). Thus, "suggestion and expectation of cure" would have enhanced the outcome when a particular medicinal product was taken either in ancient or modern times. On the other hand, it is not the absolute verification of pharmacological action with which the Thera population would have been impressed; it is pre-

⁷Rehak (1999, 2002) has discussed some medical applications of saffron. We do not address the riboflavin and vitamin A precursors known to be among the phytochemicals in saffron because there is no convincing evidence of riboflavin or vitamin A deficiency in the Thera population. If indeed the conjunctival red-streaking seen among the women portrayed in Xeste 3 does represent a disease, it is very unlikely that this is caused by a vitamin deficiency, because cereals, peas, beans, lentils, the liver of ruminant animals, and some seafood were readily available at Thera and/or Crete at the time of the frescoes (Sarpaki 1992; Tzedakis and Martlew 1999, 264, 266). However, the *Ebers Papyrus* attests to the recognition of "bloodshot" eyes at least in Egypt (Walker 1996, 141).

Chlamydia trachomatis can cause oculogenital infections as well as trachoma; the oculogenital infections may manifest as conjunctivitis. *C. trachomatis* infections of the eye and of the female genital tract may have been the target of saffron treatment, by collyrium and ingestion, in Thera and other cultures.

sumed that saffron's wide range of medical functions would have been appealing to this ancient island people.

Additionally, the Xeste 3 painting contains a feature that could reinforce saffron's effectiveness, namely the goddess almost touching the stigmas from the offering basket. In the ancient East Mediterranean, healers or worshippers frequently invoked the aid of a deity to potentiate a medicine. For example, the Egyptian god Re enhanced an ointment's effect when the folk healer incanted the revelation that Re had invented the treatment or that the ointment derived from Re's sweat or eye. In the Levant, a mineral-type medicine met with heightened success because it was "discovered" by Ishtar (Jayne 1925, 133–34). Elsewhere, the physician or magical-expert derived his authority from gods like Ea, Marduk, Nabu, or Ninurta for pain relief or a soothing eye-bandage saturated with plant drugs (Ritter 1965, 310–21). Conversely, a physician's treatment might fail until the name of the "Great Goddess" was invoked. This interaction between the human patient and the spiritual influence of the divine god provided a cure through supernatural force.

Despite the fallacy of such medicinal omnipotence (from the viewpoint of the modern observer) and the illusory nature of divine reinforcement, the success of plant therapy lay in the conviction that healing would truly take place. That is, the magic of the fresco and its goddess possibly had real validity in human life by enhancing saffron therapy at Akrotiri. Saffron's strength was not only in its pharmacological effect (in some cases), but also in the spiritual belief that the desired response would actually manifest. The goddess inspired the confluence of human and divine effort to ward off disease.

Regardless of the potential influence of this divine immanence, there is no evidence that the Therans directly borrowed stylistic or iconographic elements from Egyptian, Anatolian, or Levantine images of any specific goddesses. If the idea of a goddess of medication was not imported from foreign sources, it may be concluded that the Therans originated it independently.

While saffron's expense may explain its omission from most modern pharmacotherapeutic texts, even minuscule doses of saffron may exhibit powerful effects. For example, very low microgram quantities of crocetin are known to augment the motility of green algae gametes in its reproductive activity (Grisolia 1974; Sasstry, Srinivasan, and Subrahmanyam 1955).⁸ Regardless of the inordinate expense, the *Martindale Pharmacopoeia* cites saffron as being included in the official pharmacopoeias of the following countries: Argentina, Belgium, Austria, Chile, France, Germany, Japan, Yugoslavia, Mexico, Netherlands, Portugal, Romania, Spain, and Switzerland (Blacow 1972). However, irrespective of their efficacy, the dosage of

⁸Fieser and Fieser (1944) described the dilution (to the degree of Avogadro's 6.02×10^{23}) of crocin required to obtain "one molecule . . . to render 1 gamete motile"; the addition of crocetin esters resulted in copulation of this chlamydomonas. The extreme chemical potency of saffron is also reflected in the very small dosage used in some formularies. This extraordinary phenomenon could confirm the conviction that saffron is a very active biological agent.

saffron and its constituents has not been standardized. The “usual” dosage of powdered saffron (or its equivalent) for the majority of indications mentioned above ranges from 10 to 2,000 milligrams per day—even though more than two grams has been used as an abortifacient and may cause serious side effects.

The traditional medicinal use of saffron has continued for almost four millennia and is also currently enjoying popularity in investigational pharmacology. The ancient Therans’ extraordinary preoccupation with saffron and the crocus flower may have been caused by the apparent universal utility of the crocus plant. In support of this contention, other civilizations contemporaneous with the Therans and having cultural affinities with Thera used saffron medically; however, no culture outside the Aegean invested the degree of artistic effort concerning saffron as is displayed at Akrotiri.

ARE THERE INTERCONNECTIONS?

The ancient Egyptian *Ebers Papyrus* displays a notion of pathogenesis constituting the earliest empirical and comprehensive disease theory in history and provides a physiology, explaining the onset of disease, aging, death, the rationale for diet, and the effectiveness of medicine (Ritner 2001, 2:354). Similarly, the Mesopotamian sources (and the *Edwin Smith Papyrus*) discuss diagnoses, prognoses, and treatment including surgery (Ritter 1965; Thompson 1923, iii–iv; Wilson 1996).

Contemporaneous with these ancient written sources are the Egyptian sculptures of people suffering from various ailments, such as emaciation, dwarfism, tuberculous kyphosis, leg atrophy, and hyperlordosis (Filer 1995). Although the achievement in these depictions does not rise to the level of scientific medicine, the images do reveal a sophisticated degree of close observation and an interest in abnormalities. This may have contributed to a growing body of medical information and insights to which the Therans were exposed. In at least one respect, however, the Thera artist may have surpassed the Egyptian regarding the use of reasoned illustration: regardless of the extensive number of images of plants in ancient Egypt, the Thera depiction of *C. cartwrightianus* is an example of superior Aegean expertise in artistically rendering botanical detail in therapeutic plants (Manniche 1989, 160; Porter 2002; Vlachopoulos 2000, 646).

Furthermore, although no human skeletal remains have been found at Akrotiri, ossuaries and cemeteries in Crete have disclosed significant paleopathological information about the Bronze Age (McGeorge 1988). Studies of more than 8,000 human bones, including Early and Middle Minoan cave deposits (2600–1700 BCE) demonstrate an orthopedic phenomenon unusual for such an ancient culture: successfully healed extremity fractures, which are difficult to treat by manipulation.⁹ Healing of the fractures without appropriate reduction and

⁹Osteological analysis of remains in Minoan Crete has revealed a mean life expectancy of 31 years for men and 28 years for women. There were a few septuagenarians. Bone metastases were found,

prolonged immobilization would have been impossible, thus revealing the existence of outstanding medical skill. In addition, there is evidence of non-trephination cranial surgery, as well as dental extractions associated with excellent healing of the jaws (McGeorge 1988). In contrast, based on a study of almost 1,200 individuals from the single burial site at Qubbet el Hawa that spans the 6th to the 26th Dynasties, there is no evidence of dental extractions performed at comparable times in Egypt (Rösing 1980).

SAFFRON: A MEDICINE SPECIFICALLY FOR WOMEN?

Whether or not the crocus fresco depicting women can be interpreted as a gynecentric medical cult linked with saffron, one can infer that a significant percentage of the indications for saffron have been devoted to obstetrical and gynecological concerns. Were there medical specialties in existence in the Bronze Age?

Egyptian and Mesopotamian medicine in the Middle and Late Bronze Age, was characterized by specialized practice (Bardinet 1995, 302, 361; Ghalioungui 1983, 77–78; Oppenheim 1977). The medical papyri, including the gynecological *Kahun Papyrus* (c. 1900 BCE) and the *Ramesseum Papyri III–V* (18th to 17th centuries BCE), list the most dominant specialties as gynecology, surgery, and ophthalmology (Oppenheim 1977; Redford 2001; Reisner 1905). Peshet, an Egyptian female physician, was mentioned in the 5th or 6th Dynasty, as an overseer of female physicians (Ritner 2001, 353). Women in Mesopotamia were also allowed to train to become physicians (*asû*) (Wallenfels 2000, 3:84). The remarkable variety of gynecological and obstetrical symptoms and diseases suffered by women as well as the numerous remedies specifically for them described in these ancient medical texts show that the distress and well-being of women received particular medical attention. Also pertinent in the preceding detailing of the therapeutic uses for saffron, 14% of the indications are obstetrical-gynecological. The risks of disability and death from gynecological conditions, concerns for fertility, and the threat of death in childbirth and among neonates would represent a strong motivation for women to search for prophylactic and therapeutic medicines in addition to protection from a deity.

The female illnesses referenced in the above ancient texts (*Kahun*, *Ebers*, and *Ramesseum Papyrus*) include vulvitis, pains in the vulva, pruritis, leukorrhea, uterine prolapse, metrorrhagia, uterine cancer, pelvic pain, infertility, dystocia, and diseases of the breasts such as mastitis (Bardinet 1995, 437–41; Civil 1974, 331).¹⁰

indicating that the Minoans did indeed suffer from malignancy; therefore, the antineoplastic activity of saffron would theoretically have been therapeutically relevant at the time of the fresco painters. In addition, two vitamin deficiencies were uncovered: rickets (vitamin D) and scurvy (vitamin C) (McGeorge 1988).

¹⁰Medications described in the above ancient texts were used to promote lactation, contraception,

There is mention of a female idiot, hermaphroditism, venereal disease, the birth of infants with congenital anomalies, such as conjoined twins; and the performance of Caesarian section carried out in a dying mother or post-mortem by Egyptian female surgeons (Biggs 1969; Graham 1951, 16; Leichty 1970; Leonardo 1944, 20; Powell 1993, 62; Stevens 1975).

Regarding the reproductive specialty, the *Edwin Smith Papyrus*, *Kahun Papyrus*, and Gardiner's *Egyptian Grammar* demonstrate that the Egyptian physician was aware of the diagnoses and/or terminology of amenorrhea, placenta, prolapse, pessary, obstruction above the vulva, pregnancy, birthing, coitus, pelvic region, suckling, wife, widow, and measures for a successful childbirth following a prior miscarriage (Douskos 1980, 141–43; Gardiner 1957, 492; Stevens 1975; Walker 1996, 40, 119, 145, 243). One devastating example is the postpartum complication of vesicovaginal fistula, which is recognized in the *Kahun Papyrus*; a paleopathological and historical instance of this birth injury is that of the 11th Dynasty mummy of Princess Hehenhit (Reeves 1992, 19). Although nothing from the Minoans comparable to the Egyptian or Assyrian medical texts has as yet been found, this extensive interest in medical and medicinal phenomena to the south and east of the Aegean created the potential zones of influence on the Therans that may have resulted in the unique artistic ethnomedical manifestations at Xeste 3.

However, the evidence for an actual link between saffron and gynocentrism at Thera is unclear. In addition to the Xeste 3 scene of women strongly associated with saffron, there are other scenes elsewhere of Theran women without saffron and saffron without Theran women. Also, neither Linear A nor Linear B scripts reveal any symbolism connecting women to saffron. There are no consistent data favoring the concept of a gynocentric medicinal crocus cult at Akrotiri. Thus, the large number of obstetrical-gynecological indications for saffron's use (14% of

and abortion, to enhance fertility, to prevent miscarriages, to induce labor, and for transurethral therapy (Biggs 1969; Ghalioungui 1983, 200, 212; Jacob and Jacob 1993, 62, 64; Walker 1996, 39). Pinene and castor oil were utilized topically for increasing scalp hair growth in women, ostrich egg was used for scalp rash and bad body odor, dried liver of swallow was employed as an abortifacient, cannabis seed was engaged for menstrual disorders, and phytochemically treated vaginal tampons were generally prescribed (Bardinet 1995, 290; Biggs 1969; Ghalioungui 1983, 84, 130). Some of the preparations were spermicidal, and some were antiperspirants (Ghalioungui 1983, 181; Stevens 1975, 951; Walker 1996, 39). Chronic inflammation of the uterus was treated with a vaginal douche containing *Cannabis sativa* or celery; douching was also prescribed for cystitis, and an acacia-containing douche was used for vaginitis (Bardinet 1995, 437–43; Kamal 1967, 204–10). The *Ebers Papyrus* had a remedy for the expulsion of the placenta (Walker 1996, 40). Mental depression (“a woman who likes to sleep, she does not get up”) was attributed to contraction of the uterus (hysteria?) and treated with emetics (Biggs 1969). One woman's illness was contagious (Biggs 1969; Oppenheim 1977, 104, 286, 304). Her name was Nanname and she had been at the Mari palace of Zimri-Lim c. 1700 BCE. She developed a febrile illness and was described as having “come into contact with many other women.” Isolation techniques were implemented while her fever was designated as “contagious” (Dalley 1984, 121).

the total, from the 2nd millennium BCE to the beginning of the 3rd millennium CE) signifies that saffron may have contributed to a female reproductive specialty, but this specialization did not necessarily occur at Akrotiri.

PHYTOESTROGENS AND WOMEN'S USE OF SAFFRON

While there are questions concerning the existence of a gynecentric cult at Akrotiri, the continued interest in associating women with saffron can be seen in the long post-Bronze Age history of this ethnomedicine. The impetus for concentrating on this history lies in both the fruitful practical experience with saffron and the revealing pharmaco-chemistry of the drug, as well as its prevalence in the fresco. Also, saffron has long been valued for its effectiveness in treating many gynecological conditions. Recent chemical analysis of saffron sheds light on its pharmacological value for gynecological diseases.

Since the early 20th century CE, there has been an effort to investigate those plants to which folklore attributes value in regulating menses, fertility, and childbirth. These studies have demonstrated the existence of active herbal principals estrogenically or anti-estrogenically affecting the female reproductive system; some are steroidal estrogens, and some non-steroidal substances mimicking female sex hormones. Both of these groups are found in *C. sativus*.

The birth control pill, employed for nearly 50 years, is among the most profitable pharmaceutical products. The ultimate popularity of oral contraceptives resulted from the successful mass production of progesterone, which was developed from yam research (Hatcher et al. 1976, 37). Not only does this example provide insight into the importance of medicinal phytochemicals, but, in addition, the plant origin of progesterone (which is metabolized in humans to estrogen) was the initial step for the now generally recognized presence of estrogens and progestins in the plant world. Also, there have been innumerable examples of other plant products that contain human female sex hormones. These plant products have components that mimic the actions of the hormones or have a biochemical influence on the diverse physiological or pathological aspects of the female reproductive system (Guerre and Andrade 1978; Harbonne 1988, 122-28). One of these ethnopharmaceuticals is saffron.

Convincing evidence of saffron having a specific pharmacological action on the female reproductive system resulted from modern studies of crocus preparations stimulating the uteri of several mammals (Pei-Yen et al. 1964). It was concluded that *C. sativus* extracts myogenically and neurogenically affected isolated uteri, while the vaginal epithelium (from intact animals given oral crocus extracts) exhibited endocrine-like changes.

To biochemically confirm saffron's authenticity, note that both the vaginal suppository (dinoprostone) and oral preparation (misoprostol) of prostaglandins currently used to terminate pregnancy have chemical configurations closely

analogous to crocin (Grisolia 1974).¹¹ Evidently under certain conditions, the phytoestrogens, terpenes, and prostaglandin-like chemicals in *C. sativus* and saffron exhibit properties which potentially control metrorrhagia, induce labor or abortion, etc. This phytochemistry may partially explain the utility saffron has enjoyed for 4,000 years in treating gynecological and obstetrical indications (Duke 2001, 148–49; Graham 1951, 16; Hartwell 1982, 248–50; Lewis and Elvin-Lewis 1977, 329; Rios et al. 1996; Tang and Eisenbrand 1992; Temkin 1956, 56, 78, 122, 161, 239). Therefore, it should not be astonishing that the Therans appear to have focused upon saffron. The Therans knew nothing of estrogen, but they may have recognized saffron's estrogen-based utility for the maladies of women.

Significantly, the ancient Egyptians used turpentine and other pinene sources for the induction of labor and relief of menstrual and urinary disorders (Bardinet 1995, 61, 437–43; Ghalioungui 1983, 201, 205). Pinene is present in the crocus stigma (Duke 1992, 203); remarkably, the chemical structure of pinene closely approximates that of safranal (one of the terpenes in saffron). The word *terminthos* (“turpentine tree”) is believed to be of Aegean (non-Indo-European) origin, and probably from late 3rd to early 2nd millennium BCE Minoan Crete (Renfrew 1998, 244, 261). If this Egyptian gynecological practice of prescribing terpenes was successful, as implied by the *Ebers Papyrus*, it suggests that the saffron (containing these terpenes) may indeed have been used for the same reasons in women at Thera.

THERAPY AT THERA

The earlier chronological listing of 90 medical indications for saffron has no direct impact on 17th-century BCE Theran herbal practice, because most of the prescriptions for this phytotherapy appear after the Bronze Age. Nonetheless, a corollary can be made from these extraordinary therapeutic observations. Considering saffron's palliative success for many forms of human suffering, the Therans' dominant display of saffron may imply that they, too, had discovered one or more of the dozens of medical uses of this plant. Additionally, the continuity, number, and varied uses of saffron make it a candidate for one of the few “panaceas.” Also, saffron's consistency in imputed effectiveness has been linked to specific symptoms and diseases over many millennia which, in turn, may have

¹¹The hormonal prostaglandins are oxidized eicosanoids used in inducing abortion. In their chemical configuration, the resemblance of the carotene glycosides (and crocin) in saffron to the eicosanoids is based on the mutual similarity to trihydroxy fatty acids which exhibit prostaglandin-like clinical activity (Bundy 1985). The main difference between prostaglandin and carotene (or safranal) is that the former is a cyclopentane and the other a cyclohexane; there is a consensus that the five-membered ring (the cyclopentane) is not necessary at the prostaglandin receptor (Panosian 1980).

supported saffron's place among the most useful of all ethnomedicines. The Therans may have discovered the same therapeutic versatility with the consequent full commitment to floral protection as seen in the fresco.

The women participating in the sacred saffron activities in the Akrotiri frescoes clearly range in age from young girls to older women (as demonstrated by their clothing, hair style, and breast development). This multi-generational spectrum is consistent with the age range appropriate for diseases extending from menstrual disorders to malignancy. On the other hand, based on both modern pharmacology and ancient medical texts, saffron therapy was also generally efficacious for large numbers of non-reproductive problems; certainly male patients would not be excluded from the benefits of saffron.

Many of the recommendations made for saffron as a crude drug in the ancient formularies correspond to the recommendations in the 20th and 21st centuries CE, providing substance to the main premises of this research. Therefore, this article further hypothesizes that the possession of a potentially effective medication probably motivated the Therans to express their devotion to therapeutic success through the monumental painting of a goddess as she controlled this floral product. From this study of but one beneficial and adaptable pharmacobotanical substance, we may surmise that the goddess of Xeste 3 was a healing deity.

It is ordinarily quite difficult to arrive at a single convincing interpretation of enigmatic prehistoric symbolism expressed in paintings such as those at Xeste 3. Prior interpretations of the frescoes included perfume, condiment, or dye production from saffron. Emphasizing the *medical* function of saffron might better justify the fresco's meaning.

POSSIBLE INFLUENCE OF THE THERAN NEIGHBORS

Catalogs of ancient deities contain numerous goddesses of health from around the world including Germany, Africa, Babylonia, India, Sumer, and China (Leach 1992). This suggests a common recognition by ancient peoples of the need for protection and healing by a female divinity. Furthermore, there were female deities involved in healing during the 2nd millennium BCE in the Eastern Mediterranean region, including goddesses specializing in medicinal plants, divine female physicians, sorceresses skilled in herbs, nurse goddesses, and medicinal plants represented as goddesses (Hastings 1928, 6:545–53, 12:609). However, there is no evidence that a foreign goddess of medicine was imported by the Therans.

In addition, modern scholarship based on archaeological, metallurgical, geographic, textual, trade route, artistic, and linguistic evidence supports the idea that there were widespread overseas connections between Thera and her neighbors. The evidence attests to innumerable contacts, but there are no grounds for the idea that saffron's primacy in healing was imported by the Therans.

There may have been multiple foreign influences in the creation of the Theran wall painting, but there are no Bronze Age texts that explain the source of the figures and themes. Yet the role of the Cycladic and Minoan people in navigation, trade, and the transmission of art is well established, indicating the cultural interweaving in the Eastern Mediterranean during the early 2nd millennium BCE (Watrous 1994). Reviews of these interrelationships have identified Anatolia, the Semitic peoples, and the Aegeans as potential influences on religion and art (Rehak and Younger 1998; Winter 2000).

The cultural links between Crete and Thera in the 2nd millennium BCE are integral to the concept of Anatolian and Canaanite–Syrian influences on Thera. The vast majority of the Aegean connections with these foreign civilizations are known for Crete rather than for Thera; however, it is generally agreed that Akrotiri came under the Minoan sphere of influence. Crete–Thera contacts range from artistic themes to architecture and pottery. For example, Crete and Thera both have images of crocus-gathering women, the same picture of the “concentrated clump” from which the crocus stalk splays out, the connection between monkey and crocus, and the Horns of Consecration (Morgan 1988, 50–51).

Ancient texts reveal early 2nd millennium BCE commerce between Anatolia, Syria, and the Aegean in silver, gold, tin, textiles, and ceramics (Albright 1940; Carbet 1998; Cosmopoulos 1991; Kupper 1973, 13; Niemeier 1991, 199; Rehak and Younger 1998; Schiering 1984). Additionally, the Tel Kabri frescoes in northern Israel show seascape events, landscape, architecture, and a swallow very close to Theran style, content, and technique (Niemeier 1991; Niemeier and Niemeier 2000). Contemporaneously, Yarim-Lim’s palace at Alalakh contains murals that exhibit Aegean influence (Niemeier and Niemeier 2000). But despite these documented interrelationships, there are no foci of therapeutic elixirs, no illustrations of crocus stigmas, and no signs of a healing deity with her *materia medica* outside of the Theran world—nothing that might suggest an alien genesis of saffron’s importance in medical treatment.

CONCLUSIONS

As suggested by ancient and modern pharmacognosy, the chief function of the crocus stigmas in Xeste 3 probably was for medicinal properties. Admittedly, this assessment may be flawed. Parallels between chemical structures, regardless of their extreme similarity, do not necessarily translate as similar pharmacological action. And despite the numerous conditions for which the successful use of saffron has been corroborated, some ailments referred to in ancient texts have no known pharmacological efficacy for saffron. Furthermore, the past efforts in translating hieroglyphic and cuneiform pharmaceutical inscriptions and identifying diseases may have been inaccurate. Also, occasionally saffron was prescribed as part of a recipe with many other ingredients, thereby creating difficulty in distinguishing

the active constituent. When the list of approximately 90 medical conditions is examined, a few of the health benefits seem to be contradictory. Some of these paradoxical effects may be explained by saffron's extreme dosage range, from micrograms to grams, with the antithetical aspects occurring at opposite ends of the dose scale. Nevertheless, these issues appear not to obviate our hypotheses.

However, we maintain that the divinity depicted in the Xeste 3 fresco is a goddess of healing, based on this predominantly medical value for saffron, its omnipotence, the iconography, and the program of the painting. The unique system at Akrotiri consisted of this goddess, her curative crocus stigmas, and the represented line of production of the special panacea. It is noteworthy that many of the medical uses to which saffron was applied by ancient practitioners in their prescriptions are now recognized in modern herbal medicine and some successful, pharmacologically verified research. But, for the Therans, it was obviously not the experimental and biochemical justifications that propelled saffron to the healing forefront; it was possibly their belief and trust in a magically botanical or supernatural force, probably associated with the experience of its successful use. In fact, pharmacodynamic research has established that, at least for a few recommendations from 2nd millennium BCE healers, the phytotherapeutic actions were authentic. This is born out by the recent use of saffron, pinene, and terpene.

The crocus plant is one of many dozens that have enjoyed reputations as traditional medicines for female reproductive health. *C. sativus* also possesses an extraordinary number of additional non-sex-specific medical uses compared to the other phytoactive products consumed since prehistory. Saffron has been the most diversely pharmacologically active and potent ethnomedicine known for almost four millennia. The Theran artists rightfully selected the crocus because it was the most pharmacologically versatile plant. With this expression of botanical power, modern phytochemical studies, comparative-historical data, and a comprehensive survey of relevant images were utilized to examine the implications of pictorial representations of this sacred medicine. This analysis, albeit unsupported by textual evidence, suggests that the Xeste 3 goddess is the earliest extant image of a healing deity portrayed with her realistically depicted phytotherapeutic agent.

In the absence of a written explanation by the Bronze Age Therans, a postulate supported by a chain of substantial evidence plus four millennia of exhaustive attestations can support further decipherment and confirmation of the above conclusions. Various Aegean Bronze Age scholars have interpreted the Xeste 3 frescoes in different ways, and a few researchers have mentioned the healing properties of saffron among its several benefits. However, this study justifies a new focus on healing as the primary function of this plant product. The healing nature of the goddess and the medicinal power of saffron are emphasized here above other explanations for the wall paintings. Certainly this goddess overseeing divine healing is more worthy of depiction in wall paintings than a deity simply dictating a common economic activity.

Furthermore, Xeste 3 may have housed therapy rooms centered on this very

useful medicinal plant. That is, the building of Xeste 3 could be interpreted as a “clinic” founded in cultic belief and possibly pharmacognostical thought. The frescoes emphasize the importance of relating the medical benefits of plants to a ritual of divine blessing. They thereby invest the clinic’s healer with the restorative power of saffron. Perhaps the healing act took place in the lower level of the building, surrounded by the frescoes of the wounded girl facing the cultic Horns of Consecration. The recessed area below ground level may have helped to imbue the curative process with chthonic qualities.

In the process of transforming cultic ideas and medical botany into art, the Thera artist created a powerful, unified composition, a composition that Betancourt (2000) suggests contains “the first true perspective in ancient wall painting” (360). The wall paintings conflate the crocus-gathering and commodity themes with scenes endowing stigmas with curative potency. The program appears to anthropomorphize the medicinal plant into the persona of a female divinity of medicine. The goddess oversees the realization of a versatile phytotherapeutic substance whose indigenous development was probably unprecedented. From the Thera perspective, was this a triumph of experience and belief over fear and disease? If so, then the frescoes resulted from an astute Aegean Bronze Age mind and the Thera artistic genius.

REFERENCES

- Adams, F. 1939. *Genuine works of Hippocrates*. Baltimore: Williams and Wilkins.
- Albright, J. F. 1940. The west and northwest in the Mari archives (c. 1775 BC). *Bull Am Schools Oriental Research* 78: 23–30.
- Arena, J. M. 1973. *Poisoning: Toxicology, symptoms, treatments*. Springfield, IL: Charles C. Thomas.
- Arnott, R. 1999. Healing cult in Minoan Crete. In *Meletemata: Studies in Aegean archaeology presented to Malcolm H. Wiener as he enters his 65th year, Aegaeum 20*, ed. P. P. Betancourt, et al., 1–6. Liège: Univ. of Liège.
- Barber, E. J. 1992. The peplos of Athena. In *Goddess and polis: The Panathenaic festival in ancient Athens*, ed. J. Neils, 102–16. Princeton: Princeton Univ. Press.
- Bardinet, T. 1995. *Les papyrus médicaux de l'Égypte pharaonique*. Lyon: Librairie Arthème Fayard.
- Basker, D., and M. Negbi. 1983. Uses of saffron. *Economic Botany* 37:228–36.
- Beecher, H. K. 1955. The powerful placebo. *JAMA* 159:1602–6.
- Betancourt, P. P. 2000. Concept of space in Thera compositional systemics. In *The wall paintings of Thera: Proceedings of the first international symposium*, ed. S. Sherratt, 359–63. Athens: Thera Foundation.
- Biggs, R. 1969. Medicine in ancient Mesopotamia. *Hist Science* 8:94–105.
- Blaow, N. W. 1972. *Martindale: The extra pharmacopoeia*, 26th ed. London: Pharmaceutical Press.
- Boulos, L. 1983. *Medicinal plants of North Africa*. Algonac, MI: Reference Publications.
- Branigan, K. 1983. Minoan community colonies in the Aegean? In *The Minoan Thalassocracy: Myth and reality. Proceedings of the Third International Symposium at the Swedish*

- Institute in Athens, 31 May–5 June, 1982*, ed. R. Hägg and N. Marinatos, 49–53. Göteborg: P. Åströms.
- Budge, E. A. W. 1976. *The Syriac Book of Medicines*, vol. 2. St. Helier: Armoriga.
- Bundy, G. L. 1985. Nonmammalian sources of eicosanoids. *Adv Prostaglandin Thromboxane Leukotriene Res* 14:229–62.
- Cameron, M.A.S. 1978. Theoretical interrelations among Thera, Cretan, and mainland frescoes. In *Thera and the Aegean world*, vol. 1, ed. C. Doumas, 579–92. London: G. Tsiveriotis.
- Carbet, A. 1998. The international style: A point of view from the Levant and Syria. In *The Aegean and the Orient in the second millennium: Proceedings of the 50th anniversary symposium, Cincinnati, 18–20 April 1997*. *Aegaeum* 18, ed. E. H. Cline and D. Harris-Cline, 265–70.
- Chau-jong, W., S. Song-Jui, and L. Jen-Kun. 1991. Effects of crocetin on the hepatotoxicity and hepatic DNA binding of aflatoxin B1 in rats. *Carcinogenesis* 12:459–62.
- Civil, M. 1974. Medical commentaries from Nippur. *J Near Eastern Studies* 33:329–38.
- Cosmopoulos, M. O. 1991. Exchange networks in prehistory: The Aegean and the Mediterranean in the 3rd millennium B.C. In *Thalassa, l'Egée préhistorique et la mer: actes de la troisième Rencontre égéenne internationale de l'Université de Liège, Station de recherches sous-marines et océanographiques (StaReSO), Calvi, Corse (23–25 avril 1990)*, *Aegaeum* 7, ed. R. Laffineur and L. Basch, 155–67.
- Dalley, S. 1984. *Mari and Karana: Two Old Babylonian cities*. London: Longman.
- Davis, E. 1986. Youth and Age in the Thera Frescoes. *Am J Archaeology* 90:399–406.
- Doumas, C. 1983. *Thera: Pompeii of the ancient Aegean*. London: Thames & Hudson.
- Doumas, C. 1992. *The wall-paintings of Thera*. Athens: Thera Foundation.
- Douskos, I. 1980. The Crocuses of Santorini. In *Thera and the Aegean world*, vol. 2, ed. C. Doumas, 141–46. London: G. Tsiveriotis.
- Duke, J. A. 1992. *Handbook of phytochemical constituents of ERAS herbs and other economic plants*. Boca Raton: CRC Press.
- Duke, J. A. 2001. *Handbook of medicinal herbs*. Boca Raton: CRC Press.
- Emboden, W. A. 1972. *Narcotic plants*. New York: Macmillan.
- Estes, J. W., and L. Kuhnke, 1984. French observations of disease and drug use in late eighteenth-century Cairo. *J Hist Med Allied Sci* 39:121–52.
- Fieser, L. F., and M. Fieser. 1944. *Organic chemistry*. Boston: D. C. Heath.
- Filer, J. 1995. *Egyptian bookshelf disease*. Austin: Univ. of Texas Press.
- Forsyth, P. Y. 2000. The medicinal use of saffron in the Aegean Bronze Age. *Echos du monde classique/Classical Views* 44(19):145–66.
- Gardiner, A. H. 1957. *Egyptian grammar: Being an introduction to the study of hieroglyphs*. London: Oxford Univ. Press.
- Gesell, G. 2000. Blood on the horns of consecration? In *The wall paintings of Thera: Proceedings of the first international symposium*, vol. 2, ed. S. Sherratt, 947–56. Athens: Thera Foundation.
- Ghalioungui, P. 1983. *Physicians of pharaonic Egypt*. Cairo: Al-Ahram Center for Scientific Translation.
- Graham, H. 1951. *Eternal Eve: The history of gynecology and obstetrics*. Garden City, NY: Doubleday.
- Grisolia, S. 1974. Hypoxia, saffron, and cardiovascular disease. *Lancet* 6:41–42.

- Guerre, M. O., and A. T. L. Andrade. 1978. Contraceptive effects of native plants in rats. *Contraception* 18:191–99.
- Gunther, R. T. 1934. *The Greek herbal of Dioscorides*. Oxford: Oxford Univ. Press.
- Harbonne, J. B. 1988. *Introduction to ecological biochemistry*, 3rd ed. London: Academic Press.
- Hartwell, J. L. 1982. *Plants used against cancer: A survey*. Lawrence, MA: Quarterman Publications.
- Hastings, J. 1928. *Encyclopedia of religion and ethics*, vols. 6 and 12. New York: Scribner.
- Hatcher, R. A., et al. 1976. *Contraceptive technology 1976–1977*. New York: Halstead Press.
- Hayek, T., et al. 1997. Reduced progression of atherosclerosis in apolipoprotein E-deficient following consumption of red wine or its polyphenols quercetin or catechin. *Arterioscler Thromb Vasc Biol* 17:2749–52.
- Hirschberg, J. 1982. *The history of ophthalmology*, vol. 1, trans. F. C. Blodi. Bonn: J. P. Wayenborgh.
- Hood, M. S. F. 1984. A Minoan empire in the Aegean in the 16th and 15th centuries BC? In *The Minoan thalassocracy: Myth and reality. Proceedings of the Third International Symposium at the Swedish Institute in Athens, 31 May–5 June, 1982*, ed. R. Hägg and N. Marinatos, 33–35. Göteborg: Paul Åströms.
- Immerwahr, S. 1990. *Aegean painting in the Bronze Age*. University Park: Pennsylvania State Univ. Press.
- Jacob, I., and W. Jacob, eds.. 1993. *The healing past: Pharmaceuticals in the Biblical and Rabbinic world*. Leiden: E. J. Brill.
- Jayne, W. A. 1925. *The healing gods of ancient civilizations*. New Haven: Yale Univ. Press.
- Johnson, T., ed. 1975. *The herbal or general history of plants: The Complete 1633 Edition (originally by John Gerard) as Revised and Enlarged by Thomas Johnson*. New York: Dover.
- Jones, W. H. S. 1951. *Pliny natural history*. Loeb Classical Library, vol. 6, 261–63. Cambridge: Harvard Univ. Press.
- Jones, W. H. S., et al. 1923–31. *Hippocrates*. Loeb Classical Library. Cambridge: Harvard Univ. Press.
- Kamal, H. 1967. *A dictionary of pharaonic medicine*. Cairo: National Publication House.
- Kazuho, A., and S. Hiroshi. 2000. Effects of saffron extract on its constituent crocin on learning behavior and long-term potentiation. *Phytotherapy Res* 14:149–52.
- Koehl, R. 2001. The “sacred marriage” in Minoan religion and ritual. In *Potnia: Deities and religion in the Aegean Bronze Age, Proceedings of the 8th International Aegean Conference*, ed. R. Laffineur and R. Hägg, 237–43. Liège and Austin: Univ. of Liège and Univ. of Texas at Austin.
- Kontorli-Papadopoulou, L. 1996. *Aegean frescoes of religious character*. Göteborg: Paul Åströms.
- Kramer, S. N. 1963. *The Sumerians: Their history, culture, and character*. Chicago: Univ. of Chicago Press.
- Kupper, J. R. 1973. Northern Mesopotamia and Syria. In *Cambridge ancient history II*, part 1. Cambridge: Cambridge Univ. Press.
- Leach, M. 1992. *Guides to the gods*. Santa Barbara, CA: ABC-CLIO.
- Leichty, E. 1970. The Omen series Summa Izbu. In *Texts from cuneiform sources*, ed. A. L. Oppenheim, 1–40. Locust Valley, NY: J. J. Augustin.
- Leonardo, R. A. 1944. *History of gynecology*. New York: Froben Press.

- Leung, A. 1980. *Encyclopedia of common natural ingredients used in food, drugs, and cosmetics*. New York: John Wiley.
- Levey, M. 1966. *The medical formulary or Aqrābādhīn of Al-Kindī*. Madison: Univ. of Wisconsin Press.
- Lewis, W. H., and M. P. F. Elvin-Lewis. 1977. *Medical botany, plants affecting man's health*. New York: John Wiley.
- Manniche, L. 1989. *An ancient Egyptian herbal*. London: British Museum.
- Manning, S.W., et al. 2002. New evidence for an early date for the Aegean Late Bronze Age and Thera eruption. *Antiquity* 76:733–44.
- Marinatos, N. 1984a. Minoan threskeiocracy on Thera. In *The Minoan thalassocracy: Myth and reality*, ed. R. Hägg and N. Marinatos, 167–76. Stockholm: P. Åströms.
- Marinatos, N. 1984b. *Art and religion in Thera: Reconstructing a Bronze Age society*, Athens: D. & I. Mathioulakis.
- Marinatos, N., and R. Hägg. 1986. On the ceremonial function of the Minoan polythyra. *Opuscula Atheniensi* 16:57–73.
- Marinatos, S. 1968. *Excavations at Thera I*. Athens: Archaiologike Hetaireia.
- Marinatos, S. 1976. *Excavations at Thera VII*. Athens: Archaiologike Hetaireia.
- McGeorge, P. J. P. 1988. Health and diet in Minoan times. In *New aspects of archaeological science in Greece*, ed. R. E. Jones and H. W. Catling. Athens: Moselund.
- Molnar, J., et al. 2000. Membrane associated antitumor effects of crocine-, ginsenoside-, and cannabinoid derivatives. *Anticancer Res* 20:851–68.
- Morgan, L. 1988. *The miniature wall paintings of Thera: A study in Aegean culture and iconography*. Cambridge: Cambridge Univ. Press.
- Morgan, L. 1990. Island iconography: Thera, Kea, Milos. In *Thera and the Aegean world III*, vol. 1, ed. D. Hardy, C. Doumas, and J. Sakellarakis, 252–66. London: Thera Foundation.
- Nadkarni, K. M. 1976. *Indian materia medica*, vol. 1. Bombay: Popular Prakashan.
- Nielson, H. 1974. *Ancient ophthalmological agents*. Odense, Denmark: Odense Univ. Press.
- Niemeier, W.-D. 1991. Minoan artisans traveling overseas: The Alalakh frescoes and the painted plaster floor at Tel Kabri (western Galilee). In *Thalassa: l'Egée préhistorique et la mer: actes de la troisième Rencontre égéenne internationale de l'Université de Liège, Station de recherches sous-marines et océanographiques (StaReSO), Calvi, Corse (23–25 avril 1990)*, *Aegaeum* 7, ed. R. Laffineur and L. Basch, 189–200.
- Niemeier, B. and W.-D. Niemeier. 2000. Aegean frescoes in Syria-Palestine: Alalakh and Tel Kabri. In *The wall paintings of Thera: Proceedings of the first international symposium*, ed. S. Sherratt, 763–97. Athens: Thera Foundation.
- Nixon, M. 1909. *Dutch bulbs and gardens*. London: Adam and Charles Black.
- Oppenheim, A. L. 1977. *Ancient Mesopotamia: Portrait of a dead civilization*. Chicago: Univ. of Chicago Press.
- Page, T. E. 1935. *Celsus' "De Medicina,"* vol. 2, book 6. Cambridge: Harvard Univ. Press.
- Panossian, A. G. 1980. Unsaturated polyhydroxy acids having prostaglandin-like activity from *Bryonia alba*. II. Major components. *Planta Med* 47:17–25.
- Pei-Yen, C., et al. 1964. Studies on the pharmacological action of Zang Hong Hua (*Crocus sativus* L.). *Acta Pharmaceutica Sinica* 11:94–100.
- Porter, R. 2000. The flora of the Thera wall paintings: Living plants and motifs—sea lily, crocus, iris, and ivy. In *The wall paintings of Thera: Proceedings of the first international symposium*, ed. S. Sherratt, 585–618. Athens: Thera Foundation.

- Porter, R. 2002. Personal communication.
- Powell, M. A. 1993. Drugs and pharmaceuticals in Ancient Mesopotamia. In *The healing past: Pharmaceuticals in the Biblical and Rabbinic world*, ed. I. Jacob and W. Jacob, 46–67. Leiden, Netherlands: E. J. Brill.
- Pritchard, J. B. 1969. *Ancient Near Eastern texts relating to the Old Testament*. Princeton: Princeton Univ. Press.
- Redford, D. B. 2001. *Oxford encyclopedia of ancient Egypt*, vol. 2. Oxford: Oxford Univ. Press.
- Reeves, C. 1992. *Egyptian medicine*. Buckinghamshire: Shire Publications.
- Rehak, P. 1999. The Aegean landscape and the body: A new interpretation of the Thera frescoes. *Br Archeological Rep (Intl Series)* 812:11–21.
- Rehak, P. 2002. Imag(in)ing a women's world in Bronze Age Greece: The frescoes from Xeste 3 at Akrotiri, Thera, In *Among women: From the homosocial to the homoerotic in the ancient world*, ed. N. S. Rabinowitz and L. Auanger, 34–59. Austin: Univ. of Texas Press.
- Rehak, P., and J. G. Younger. 1998. Review of Aegean prehistory. VII. Neopalatial, final palatial, and postpalatial Crete. *Am J Archaeology* 102:91–173.
- Reisner, G. A. 1905. *The Hearst medical papyrus*. Leipzig: Hinrichs.
- Renfrew, C. 1998. Word of Minos: The Minoan contribution to Mycenaean Greek and the linguistic geography of the Bronze Age Aegean. *Cambridge Archaeological J* 8:239–64.
- Riddle, J. M. 1985. *Dioscorides on pharmacy and medicine*. Austin: Univ. of Texas Press.
- Riddle, J. M. 1992. *Contraception and abortion from the Ancient World to the Renaissance*. Cambridge: Harvard Univ. Press.
- Rinpoche, R. and J. Kunzang. 1973. *Tibetan medicine illustrated in original texts*. Berkeley: Univ. of California Press.
- Rios, J. L., et al. 1996. An update review of saffron and its derivative constituents. *Phytother Res* 10:189–93.
- Ritner, R. K. 2001. Medicine. In *Oxford encyclopedia of ancient Egypt*, vol. 2, 321–56. Oxford: Oxford Univ. Press.
- Ritter, E. K. 1965. Magical-expert (=ĀŠIPU) and physician (=ASŪ) notes on two complementary professions in Babylonian medicine. In *Studies in honor of Benno Landsberger on his seventy-fifth birthday, April 21, 1965*, 299–321. Chicago: Univ. of Chicago Press.
- Rösing, F. W. 1980. Medical papyri and medical treatments: A contradiction. *Antropologia Contemporanea* 3:1–7.
- Rowland, B. 1981. *Medieval woman's guide to health*. Kent: Kent State Univ. Press.
- Sarpaki, A. 1992. A palaeoethnobotanical study of the West House, Akrotiri, Thera. *Annu British School Athens* 87:219–30.
- Sarpaki, A. 2000. Plants chosen to be depicted on Thera wall paintings: Tentative interpretations. In *The wall paintings of Thera: Proceedings of the first international symposium*, ed. S. Sherratt, 657–80. Athens: Thera Foundation.
- Sastry, L. V. L., M. Srinivasan, and V. Subrahmanyam. 1955. Saffron (*Crocus sativus* Linn.). *J Sci Indust Research* 14A:178–81.
- Schiering, W. 1984. The connections between the oldest settlement at Miletus and Crete. In *The Minoan thalassocracy: Myth and reality*, ed. R. Hägg and H. Marinatos, 187–88. Stockholm: Paul Åströms.

- Seyde, W. C., et al. 1986. Carotenoid compound crocetin improves cerebral oxygenation in hemorrhaged rats. *J Cereb Blood Flow Metab* 6:703–7.
- Soeda, S., et al. 2001. Crocin suppresses tumor necrosis factor- α -induced cell death of neuronally differentiated PC-12 cells. *Life Science* 69:2887–98.
- Staden, H. von. 1989. *Herophilus: The art of medicine in early Alexandria*. Cambridge: Cambridge Univ. Press.
- Stevens, J. M. 1975. Gynaecology from ancient Egypt: The Papyrus Kahun. *Med J Aust* 2: 949–52.
- Tang, W., and G. Eisenbrand. 1992. *Chinese drugs of plant origin*. Berlin: Springer Verlag.
- Temkin, O. 1956. *Soranus' gynecology*. Baltimore: Johns Hopkins Univ. Press.
- Thompson, R. C. 1908. Assyrian prescriptions for diseases of the head. *Am J Semitic Languages* 24:323–53.
- Thompson, R. C. 1923. *Assyrian medical texts from the originals in the British Museum*. London: Oxford Univ. Press.
- Thompson, R. C. 1924. *The Assyrian herbal*. London: Lusac.
- Thompson, R. C. 1949. *A dictionary of Assyrian botany*. London: British Academy.
- Toussaint-Samat, M. 1992. *A history of food*. Cambridge: Blackwell.
- Tzedakis, Y., and H. Martlew. 1999. *Minoans and Myceneans: Flavours of their time*. Athens: Production Kapon Editions.
- Vlachopoulos, A. 2000. The reed motif in the Thera wall paintings and its association with Aegean pictorial art. In *The wall paintings of Thera: Proceedings of the first international symposium*, ed. S. Sherratt, 631–56. Athens: Thera Foundation.
- Walker, J. H. 1996. *Studies in ancient Egyptian anatomical terminology*. Warminster, England: Avis and Phillips.
- Wallenfels, R. 2000. *The ancient Near East*, vol. 3. New York: Scribner.
- Walsh, P. 2000. *Physician's desk reference for herbal medicines*. Montvale, NJ: Medical Economics.
- Warren, P. M., and V. Hankey. 1989. *Aegean Bronze Age chronology*. Bristol: Bristol Classical Press.
- Watrous, V. 1994. Review of Aegean prehistory III: Crete from earliest prehistory through the protopalatial period. *Am J Archaeology* 98:695–753.
- Weaver, W. W. 2001. *Saver's herbal cures: America's first book of botanic healing 1762–1778*. New York: Routledge.
- Wiener, M. H. 1990. The isles of Crete? The Minoan thalassocracy revisited. In *Thera and the Aegean World III. Vol. 1: Archaeology. Proceedings of the Third International Congress, Santorini, Greece, 3–9 September 1989*, ed. D. A. Hardy, C. G. Doumas, J. A. Sakellarakis, and P. M. Warren, 128–61. London: Thera Foundation.
- Wilson, J. V. K. 1996. Diseases of Babylon: An examination of selected texts. *J Roy Soc Med* 89:135–40.
- Winter, I. J. 2000. Thera paintings and the ancient Near East. In *The wall paintings of Thera: Proceedings of the first international symposium*, ed. S. Sherratt, 745–62. Athens: Thera Foundation.
- Wiseman, H., et al. 1997. Influence of the dietary flavonoid quercetin on the cardioprotective antioxidant action of estrogen and phytoestrogens. *Biochem Soc Trans* 25:108S.
- Zarghami, N. S., and D. E. Heinz. 1971. Monoterpene aldehydes and isophorone-related compounds of saffron. *Phytochemistry* 10:2755–60.
- Zava, D. T., C. M. Dollbaum, and M. Blen. 1998. Estrogen and progestin bioactivity of foods herbs and spices. *Proc Soc Exp Bio Med* 217:369–78.