

## Main Menu

Home

2012 June 5-6  
Witness the spectacle!

History  
Centuries of Discovery

1639 Transit  
A Most Agreeable Spectacle

1761 & 1769 Transits  
Global Expeditions

1874 & 1882 Transits  
Age of Photography

2004 Transit  
The Digital Era

2012 Transit  
Last of a Lifetime

Black Drop Effect  
Visual Mystery

Other History

Eye Safety  
Viewing the Sun

Education  
Lots of resources

Store

Misc.

Site Map

History 1874 & 1882 Transits

## Between Captain Cook and Mauna Kea: The British 1874 Transit of Venus Expedition to Hawaii

Michael Chauvin

An illustrated lecture delivered at the Smithsonian Institution  
in Washington, D.C., on June 7, 2004

### Introduction



Captain James Cook

The beginning of modern astronomy in Hawaii can be dated to the arrival, in 1778, of the British explorer Captain James Cook (Fig. 1). In addition to being supplied with state-of-the-art navigational instruments – including the sextant and the chronometer – Cook also carried, on each of his two ships, the Resolution and the

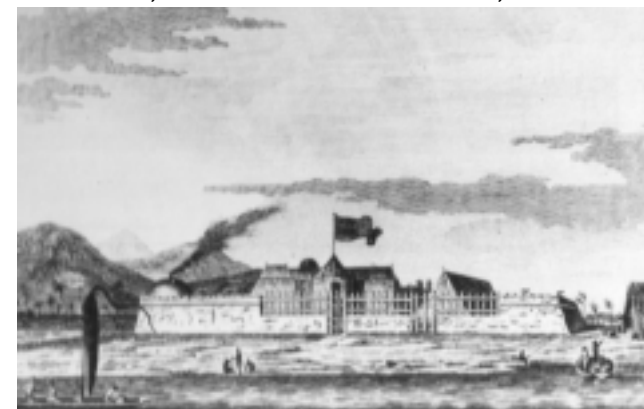


Portable observatory designed by astronomer William Bayly

Discovery, a portable astronomical observatory (Fig. 2) designed by the astronomer William Bayly. Very much like the modern observatories that now populate the summit of Mauna Kea, Bayly's observatory sheltered a telescope and a clock and was equipped with a revolving dome that could be opened and closed at will. With these astronomical aids at his command, Cook was able to do what no one prior to his time had ever done: He was able to assign the islands a latitude and a longitude, and thus to place Hawaii on a map (Fig. 3).

Observations of Jupiter's satellites, for example, helped to fix the longitude of Kealakekua Bay for the first time in history; and as the distance between the Prime Meridian at Greenwich and a tropical island paradise became as firmly defined as the science of the day would allow, a British presence became firmly established in Hawaii.

Captain Cook was killed in 1779 at this very location, Kealakekua Bay – a place to which I shall return later in my story. Ten years earlier, his first Pacific voyage had taken him into the South Pacific where, in June of 1769, he had observed, from the island of Tahiti, a rare transit of the planet Venus across



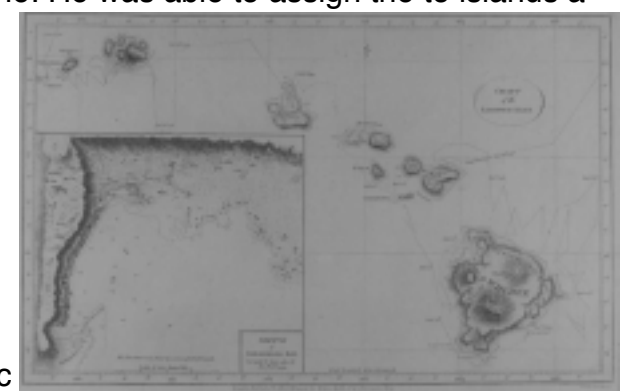
Fort Venus on the island of Tahiti

the sun. At Tahiti, a temporary garrison called Fort Venus (Fig. 4) provided a safe haven for Cook's men and their instruments and the transit was observed under sunny skies. But, just as importantly, many of the elements of this pioneering eighteenth-century enterprise – the passing of a planet in front of the sun, the demonstration of British naval and navigational prowess, the transport of observers and equipment to a remote Pacific island, and the construction of a temporary fortress – proved a good rehearsal for what was to occur in Hawaii more than 100 years later.

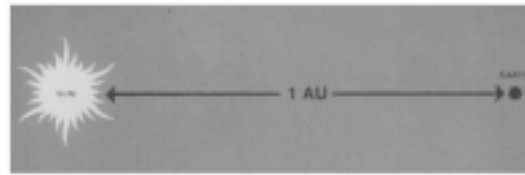
When, in 1874, Venus again slithered across the sun, the British were once more active in the Pacific, and Hawaii, where British cultural influences were by then easily recognizable, was very much at the center of the

enterprise. Cook's three voyages of exploration, including his voyages to Tahiti and Hawaii – and, in particular, the astronomy that had informed those voyages – had set the stage for even more ambitious endeavors.

Not long after Cook's arrival in Hawaii, the islands were united under a single ruler, Kamehameha the Great, and soon thereafter adopted for their government a European-styled monarchy. By the latter half of the nineteenth century, Hawaii had been ruled by a succession of hereditary chiefs, or ali'i, and was still an independent kingdom when, on September 9, 1874, nearly a century after Captain Cook had appointed Hawaii a position on a map, a ship from England, HMS Scout, sailed into Honolulu Harbor carrying an expedition of seven astronomers (Fig. 5).



Map of Hawaii 1778-1779



The Astronomical Unit (AU)

The mission of the expedition was – as Captain Cook’s had been in 1769 – to observe a rare transit of Venus across the sun for the purpose of better determining the value of the Astronomical Unit (Fig. 6) – that is, the Earth-sun distance – and thereby the absolute scale of the solar system. For although



Members of the British 1874 transit of Venus expedition in Hawaii

Copernicus had, by the 16th century, put the known planets in their correct order and had derived from his model of the solar system a set of relative distances among its members, their absolute distances remained hostage to the uncertain value of the Astronomical Unit (AU). Astronomers still needed a celestial yardstick of known length to measure distances among the planets and to link the planets to the stars beyond.

The circumstances of a transit of Venus and its relationship to the Astronomical Unit are, I shall assume, well known to people in this room and need not detain us here. They form the subject matter of a fine exhibition now on display here at the Smithsonian Institution, and the American participation in the transit observations of the nineteenth century is retold in the exhibit. But because Hawaii was still an independent kingdom at that time, and not an American state until 1959, it is my task today to tell you something about Hawaii’s role at the center of an international effort to solve what was once considered the most important problem in observational astronomy.

### Hokuloa: The British 1874 Transit of Venus Expedition to Hawai‘i (abridged)

The British transit of Venus operations in the Hawaiian Kingdom extended over a period of six months, from September 1874 to March 1875, and attracted widespread attention from all ranks of Island society. As one might expect, the full story of these operations cannot be entirely bereft of lessons on social stratification and class privilege, nor is it entirely unlike the story of triumph and tragedy surrounding the name of Galileo: The pursuit of a fundamental astronomical truth is inextricably intertwined with abundant human drama. From accusations of madness and incompetence, to episodes of insobriety and seduction; from music and merry-making, to an earthquake and a volcanic eruption; from mosquitoes on the land, to a drowning in the sea; from the positions of British militiamen, to the impositions of Hawaiian royalty; from astronomical frustrations, to gastronomical celebrations – Hawaii provided the stage upon which polite Victorian astronomy was conducted in a teetering kingdom on the verge of being swallowed up by a global power. Indeed this chapter in Hawaiian history, virtually untold until very recently, is chock-a-block with both personality and peradventure.



Foremost among those personalities is George Forbes (Fig. 7). Born in Edinburgh and educated at Cambridge, Forbes was only twenty-five years old when he arrived in Honolulu as a member of the British team. A man of versatile talents – a traveler, a journalist, an inventor, and an electrical engineer, as well as an astronomer – Forbes eventually took command of the auxiliary transit station at Kailua-Kona on the island of Hawaii, about twelve miles north of Kealahou Bay. Among his personal papers, still preserved at St. Andrews University in Scotland, there is a story – a story unpublished until this year – that climaxes his involvement in the British transit chase with a Hollywood blockbuster-of-an-adventure.

Forbes’s observing partner at Kailua-Kona was Henry Barnacle (Fig. 8). Born in Cheshire and educated, like Forbes, at Cambridge, Barnacle proved to be an otherwise incongruous partner and was eventually banished from the expedition altogether. Although his mathematical and astronomical ineptitude may have been cause for genuine concern, even more so was his general lack of intellectual and moral virtue. The expedition’s leader seems to have believed that Barnacle was not in his right mind – thinking him either mad or the greatest impostor who ever lived – and told the Astronomer Royal by letter from Hawaii that Barnacle could not be entrusted with anything as he never told the truth, not even by accident. Compelled to return to England early, Henry Barnacle threatened his presumed detractors with legal action. Repeatedly frustrated in his pursuit of a scientific career, he was ordained a deacon in 1877 and finally emigrated to Australia where he died in 1938.



Fig. 9

Another Cambridge-educated man who enters our story (and there are many) comes in through the back door. Although a rather obscure figure in the history of science, many of you here today will know of the work of his brother George, and all of you, I think, will know of the work of his father Charles. The man’s name was Leonard – Leonard Darwin (Fig. 9).

Charles Darwin enters our story through his *Descent of Man*, just published in 1871 and containing the author’s speculations about the eventual extinction of the Hawaiian race. Leonard enters our story through what might be called “the Cambridge network” when his father wishes to bring to the attention of another

Cambridge celebrity, Astronomer Royal George Airy, the desire of his son Leonard to partake of the 1874 transit of Venus enterprise. Charles Darwin’s letter to Hubert Airy, George’s son, turns the trick and Leonard is hired. He eventually sails into the Pacific – to New Zealand – and then on to Hawaii for a post-transit encounter.



For those of you harboring more affection for New England than England, you may be pleased to hear that two Yale-trained astronomers are also in our story. One of these, Chester Smith Lyman (Fig. 10) once taught at the Royal School in Honolulu when several royal children were students there and by 1874 had become a professor of astronomy at Yale. The other,



Fig. 11

William DeWitt Alexander (Fig. 11), had studied at Yale and in 1874 was Hawaii's Surveyor General.

Alexander, in fact, played a pivotal role in connecting the British celestial enterprise to Hawaii's terrestrial concerns when he realized how the British transit team could render invaluable assistance to the Hawaiian Government Survey by obtaining and sharing latitude and longitude measurements with a degree of accuracy never before attained in the Hawaiian Islands – and far surpassing the efforts of Captain Cook a century earlier.

Indeed, when the transit of Venus expedition arrived and established itself in Honolulu, the instruments with which they equipped their observatory – instruments that included much more than mere telescopes – were strongly indicative that the simple observation of Venus against the sun was not their sole concern: So too was the meticulous parceling of Hawaii's tiny amount of real estate.



Fig. 12

Surely one of the more easily recognized names in our story is that of George Airy (Fig. 12), England's seventh Astronomer Royal at Greenwich and the prime mover behind the British 1874 enterprise. Airy favored, for the 1874 transit observations, the method not of his countryman Edmond Halley, but of the Frenchman Joseph-Nicolas Delisle. Unlike Halley's method, that of Delisle required observations not of the entire transit but only of its most critical phases: internal contact, at ingress or egress, from a pair of widely separated stations. If – Airy argued – if observers could be stationed in the Hawaiian Islands, where the British had already established a social and political preeminence, and if the weather cooperated,

Hawaii's location, at one extremity of a long baseline, would make it an excellent place for observing internal contact at ingress. Indeed, by 1868 Airy was already calling Hawaii "indispensable" in the establishment of a Delisle station in the Pacific.

Although Airy knew this much about Hawaii, he probably knew little else. He therefore saw to it that his men were sent to foreign parts with all the presumed necessities, and much else besides. For if fastidious attention to detail was necessary for the success of the transit of Venus enterprise, Airy could be fastidious in the extreme. To give but two examples: One of his contemporaries told a story that on one occasion Airy devoted an entire afternoon to himself labeling a number of wooden cases "empty", it so happening that the routine at the observatory kept every one else engaged at the time. And his friend De Morgan jocularly said that if Airy so much as wiped his pen on a piece of blotting paper, he would duly endorse the blotting paper with the date and particulars of its use and file it away amongst his documents.

To assume that a man like this would watch out for the welfare of his team is to assume rightly, and Airy's team in Hawaii was certainly well equipped. The astronomical apparatus sent to the Islands included not only three transit instruments and more than a half dozen telescopes, but a supply of silk – yes, silk – handkerchiefs for cleaning the graduated circles of the instruments. Then there were the clocks and chronometers, the compasses and micrometers, the photoheliograph and the photographic chemicals, the barometers, thermometers, hydrometers, and rain gauges. And because much of the expedition's work would need to be recorded on paper of one kind or another, a dozen or more different kinds would be supplied including letter, blotting, drawing, litmus, and photo. To help complete the stock of stationery items, there would be copybooks, memorandum books, pencils, tape, scissors, and three kinds of string – stout, medium, and fine. And because the expedition would be required to erect and labor within temporary structures, along with the scientific equipment there would go building tools: saws, chisels, crowbars, files, screwdrivers, pliers, table vices, soldering irons, hammers, nails – implements of metal that, only a century earlier, at the time of Captain Cook's arrival, would have been much coveted by stone-age Island natives. Finally, the expedition would not lack the accoutrements of English domesticity: knives, forks, spoons, cooking stoves, wash basins, coffee pots and teapots, chairs and stools, bedsteads and mattresses, blankets and sheets, candles, lanterns, lamps, and oil – all would be shipped to Hawaii. And not just oil for lamps: The astronomers would also bring their own salad oil – together with sauces, herbs, and spices; salt, pepper, and mustard; curry powder, yeast, and vinegar; pickles and raisins; biscuits and bottled fruits; almonds and tapioca; figs and dates; butter; and, for hygiene, soap. And if there were any lingering suspicions that such well-fed and well-housed anatomies would somehow wither in the tropical heat, such sufferings would not emanate from a shortage of well-chosen beverages: wine, brandy, whiskey, orange bitters, ale, Guinness Stout, breakfast claret, dinner sherry, champagne, and more would be supplied. And, lest a simple oversight lead to a denial of the merited libations, a supply of corkscrews would also be sent along.

Thus furnished with an estimated 93 tons of cargo – and a set of last-minute instructions from Airy – the British expedition left Liverpool in two contingents in June of 1874. After a brief layover at Valparaiso, Chile, the seven-man British team arrived in Honolulu in September.



The tomb of King Lunalilo in Honolulu

For Hawaii's ruling class, nothing could have been more ill timed. Only seven months earlier the death of Hawaii's penultimate king, Lunalilo (Fig. 13), had left a power vacuum in the Islands, and Lunalilo's successor, David Kalakaua (Fig. 14), ascended to the throne only after a riot in

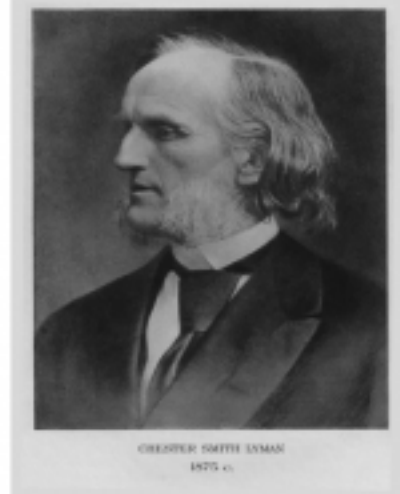


Fig. 10



King David Kalakaua

downtown Honolulu was stilled by American and British militia. The new king, besieged by political and economic instability, attempted to set things aright, but was compelled to do so at a pivotal time in Island history, when Hawaii was weaning itself away from an inveterate British influence. And although King Kalakaua was present in Honolulu both to greet the transit expedition at his palace and to bid them farewell six months later, he was nowhere to be seen when transit day arrived. He was, instead, right here in Washington for reasons that I will reveal in moment. In the meantime, American transit of Venus observers had departed Washington and had gone elsewhere (Fig. 15).



The American observing stations

In Hawaii, King Kalakaua evidenced a personal interest in the transit of Venus operations in his kingdom and placed at the disposal of the expedition a suitable piece of open land not far from Honolulu’s waterfront in a district called Apua. There, a wooden fence was erected and soon came to enclose a well-equipped nineteenth-century astronomical observatory, including a transit instrument (Fig. 16), an altazimuth (Fig. 17), a photoheliograph (Fig. 18), a number of telescopes (Fig. 19), and several temporary structures including wooden observatories (Fig. 20), a bathing tent, a cook house, and a sappers’ barrack (Fig. 21). In due course, auxiliary stations – though not so elaborate as the main station in Honolulu – would be established on two other islands: at Kailua-Kona on the island of Hawaii, and at Waimea on the island Kauai.



The transit instrument



The altazimuth



The photoheliograph



The 6-inch refracting telescope



The wooden observatories



The bathing tent, cook house, and sappers' barrack

Meanwhile, back in Honolulu, a multitude of challenges were to confront the expedition even before King Kalakaua’s departure for Washington, challenges that emanated from two principal sources: nature and society. During the weeks



The thatched roofing

leading up to transit day, nature delivered up enough heat to prompt the erection of thatched roofing in double layers (Fig. 22), enough wind to send a 90-foot coconut palm tree crashing through the observatory fence (Fig. 23), and enough rain to flood the observatory grounds and float the floors of the wooden buildings. And if Mother Nature was more than generous with her provision of a wet breeding ground for



90-foot coconut palm tree crashes through the observatory fence

mosquitoes, it was society that produced swarms of pesty bipeds; and fewer than three weeks after the expedition’s arrival, the expedition’s leader, George Tupman (Fig. 24), was already lamenting into his journal that King Kalakaua had not only interrupted the astronomers’ work with a two-hour evening visit, but that he had had the temerity to propose that if, as soon as all the instruments were mounted, the astronomers would open the observatory grounds to the public for a



The expedition's leader George Tupman

week, His Majesty would provide some additional entertainment by sending his own military band down every day!

Despite this jocund offer, and despite the fact that King Kalakaua seems to have been genuinely interested in the success of the British enterprise, when transit day came he was nowhere to be seen. On November 17, two months after the expedition’s arrival and just three weeks before transit day, King Kalakaua (Fig. 14) left Honolulu for Washington, and would not return for three months. For his prime focus at the time was not at a telescope, but at Washington where he came to leverage his personal presence on the negotiation of a treaty between the Hawaiian Kingdom and the United States. For Hawaii, the main value of such a treaty would be economic and would depend on the market value of sugar, Hawaii’s greatest commercial crop. For the United States, the treaty’s value would be both strategic and (as later events would prove) far-reaching.

Before leaving Washington, King Kalakaua would be introduced to President Ulysses Grant, he would be received by the houses of Congress in joint session, and he would get what he came for. But he would not get it without giving up something in return. When the Reciprocity Treaty was signed in January 1875, it would put Hawaii’s fragile economy on a firm basis by permitting Hawai’i-grown sugar to enter the United States duty-free. But it would also direct the Hawaiian Islands away from their long-standing flirtations with England and toward their consummate embrace with the United States; for the king would, in effect, sign away to the American Navy the rights to Pearl Harbor.

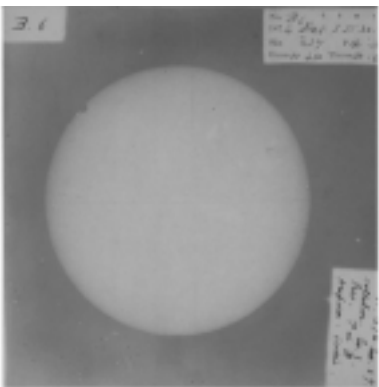


As might be expected, in the king's absence, there was a bit of turmoil in Honolulu as transit day dawned. Awash in a kingdom with an absentee king, Tupman and company were forced to cope with not a few enthusiastic but misguided subjects who, carrying with them the delusion that they could gain easy access to the telescopes, or would at least be permitted entry to the observatory on this historic occasion, brought a pathetically festive appearance to the observatory site. In the absence of the king, Queen Kapiolani and the dowager queen Emma, anticipating possible unrest in downtown Honolulu, stepped forward in an attempt to maintain public order. British Commissioner James Wodehouse appealed to the Hawaiian government for permission to land a small band of men from HMS Scout to keep the ground around the observatory clear, and by early afternoon the site at Apua had taken on the unfriendly appearance of a military fort (Fig. 26). It was a good thing too, for at about 3 o'clock hundreds of natives arrived at the gates in their holiday clothes!



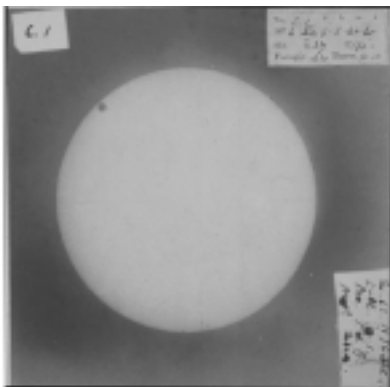
Transit Day at Honolulu

The transit of Venus occurred, as predicted, on December 8th (Hawaiian time), and the red-coated sentinels, needed or not, held their positions not only in Honolulu but at Kailua-Kona and Waimea as well. The rain clouds withdrew, the sun shone, and useful observations were obtained at two of the three observing stations, Honolulu and Waimea.



Venus approaching internal contact

The main goal of the Hawaii expedition was to observe, record, and photograph the exact instant of internal contact as Venus began to encroach upon the solar disk. This photograph (Fig. 27) was taken in Honolulu shortly before internal contact; and this one (Fig. 28) approximately five minutes after internal contact. The critical moment having been witnessed and recorded by both Tupman and one of his



Venus after internal contact

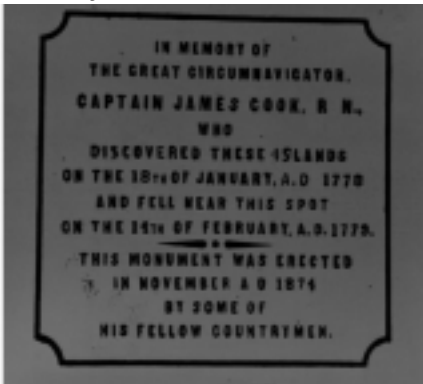
colleagues at 3h 35m 54s past noon, Honolulu Mean Time, the sun dropped into the sea at 5:18 p.m. while the transit was still in progress.

In the aftermath of the transit, the Forbes-Barnacle team at Kailua-Kona, having missed internal contact due to passing clouds, was in for a few more surprises. Barnacle was declared mad and ordered home, but lingered long enough to travel down the coast with Forbes to visit the site of the newly erected monument to their slain countrymen Captain Cook (Fig. 29). Erected in November 1874 (Fig. 30) in the midst of the British transit proceedings, the monument still stands in



Captain Cook Monument at Kealahou Bay

commemoration of two seminal episodes in the history of British-Hawaii relations: The arrival of Captain Cook and, a century later, the arrival of his Venus-chasing countrymen.



The inscription on the Captain Cook Monument

In England, the transit's aftermath included the laborious efforts to reduce the data and publish the results – an effort that encompassed many years. Airy's official Account of the British transit observations,

published in 1881, ran to more than 500 pages, fully half of which was devoted to the expedition to the Hawaiian Islands. Still, this weighty tome was but an abridgment of the bulk of the matter originally intended for publication – and there were two items conspicuously absent from the document: the name of Henry Barnacle, and a new value for the Astronomical Unit.

## Conclusion

For those of wishing to learn more about the story that I have sketched here today, the newly published book Hokuloa (Fig. 31: Tupman at the telescope) is delicious with detail. The book was in the cooking house for more than ten years before being served up to the reading world, and its prolonged preparation involved more than 100,000 miles of travel by the author to libraries, archives, and historic sites in Europe, America, and Polynesia.



George Tupman at the telescope in Honolulu  
as seen on the cover of  
*Hokuloa: The British 1874 Transit of Venus Expedition to Hawaii*

The story that Hokuloa tells begins in a time-honored way: in medias res (in the middle of things). The first 157 pages are divided up into 35 short chapters (for an average length of about 4½ pages per chapter) and read much like a historical novel. The mathematical and astronomical details of transits have been assigned to 4 separate appendices so as not to gratuitously interrupt the narrative. And for those with scholarly inclinations, there are, in the back of the book, more than 600 endnotes, many of them substantive, as well as a full bibliography.

The book's chief protagonist, George Forbes, not only launches the book but ends it with a marvelous display of fairy-tale-like heroism. And although this may seem an incongruous climax to a strictly scientific history, it will add, for some of you, a welcome bit of romance to

an otherwise male-dominated story.

Indeed, my short lecture today has been, at best, but a brief preview of the exciting tale that the fuller book contains. I hope you will read it.

The next transit of Venus is expected in June 2012. Hawaii will be well placed for the event. Perhaps I will see some of you at that time.

Until then, thank you for your kind attention, and aloha.

This lecture by Dr. Michael Chauvin was originally delivered by him on June 7, 2004, at the Smithsonian Institution in Washington, D.C. We thank him for reproducing this as an article at [www.transitofvenus.org](http://www.transitofvenus.org).

His **critically acclaimed** book, **Hokuloa: The British 1874 Transit of Venus Expedition to Hawaii**, ISBN: 1581780230, can be ordered by phone (808-848-4135), fax (808-847-8260), or email ([press@bishopmuseum.org](mailto:press@bishopmuseum.org)).

#### About the Author

Broadly educated in the U.S. at the universities of Michigan, Hawaii, and Harvard, Michael Chauvin received his Ph.D. in the History and Philosophy of Science from England's historic Cambridge University. He is a founding member of the IAU-IUHPS Inter-Union Commission for the History of Astronomy and a consultant of Commission 41 of the International Astronomical Union.

