

## **HEAVENLY-OPPORTUNITY**

For Better Photos Involving the Sun and Moon

By  
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By  
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<http://ho.fossilcreeksoft.com>

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## SHAREWARE AGREEMENT

*You can't appreciate the miracle of the sunrise unless you've waited in the darkness. – anon*

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If you find that Heavenly-Opportunity does not meet your needs, simply remove the program from your computer. Thank you.

## REGISTERING HEAVENLY-OPPORTUNITY

*by night only crazy things  
like the full moon and the whippoorwill  
and us, are busy. – Charles Olson*

A 30-day program evaluation is offered at no charge. Beyond that time, there is a registration fee payable by check or money order to Fossil Creek Software, 5402 Old Mill Rd., Fort Collins, CO 80528, USA, [FCS@FossilCreekSoft.com](mailto:FCS@FossilCreekSoft.com). Upon registration, you will be sent a personal key allowing for your unlimited future use. *Unregistered use of this software after the 30-day evaluation period is in violation of U.S. and international copyright laws.* If you would like a CD and printed copy of the documentation, there is an extra cost for the CD plus shipping and handling. Sorry, but we do not accept credit card orders except via PayPal on the website <http://ho.fossilcreeksoft.com>.

From time to time, Fossil Creek Software may release enhancements to the program. If you include your e-mail address, I can notify you of any significant changes to the program. Customer information will be kept confidential and not distributed to any third party.

## SUGGESTIONS AND ERROR REPORTS

*The sky broke like an egg into full sunset and the water caught fire. – Pamela Hansford Johnson*

I would appreciate any suggestions you might have to improve Heavenly-Opportunity. If you feel that you have discovered a problem in the software or documentation, please e-mail me. I will make every effort to repair any errors that are discovered and provide you with a working solution as soon as possible. Those who report bugs that I am unaware of will have their money gratefully refunded.

## DISCLAIMERS

*One Man's Sunset is another Man's Dawn. – Fievel Mouskawitz*

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# 1. INTRODUCTION TO HEAVENLY-OPPORTUNITY



## 1.1 Overview

*When I admire the wonder of a sunset or the beauty of the moon, my soul expands in worship of the Creator. – Mahatma Gandhi*

Ever changing but predictable cycles of the sun and moon and their association with the seasons were essential to nomadic tribes, and presumably the navigator and farmer. Indeed, the ability to measure time and predict seasonal changes formed a cornerstone to the rise of civilization. Ancient stone circles such as Stonehenge were actually some of the first astronomical observatories and the first computers. They gave their builders the ability to measure time and predict seasonal changes. Heavenly-Opportunity continues this legacy, but for the photographer.

Do you want to be prepared when you visit a new photo location? Want to plan your photo trip or vacation to catch the full-rising moon? Heavenly-Opportunity will help you find the best times and best places to take photos that involve sunrise/sunset or moonrise/moonset, or best yet, combinations of the two. The program accurately predicts the times of rise and set, their position on the horizon, the phase of the moon, and lets you search for just the right combinations to compose that shot you've been looking for. It also will stimulate ideas for photo possibilities you may not have really considered previously.

There are many tools available on the World Wide Web that do part of what Heavenly-Opportunity can do, but none are as seamless and effortless as Heavenly-Opportunity, none that will truly help put you in the right place at the right time – and you don't even need a Web connection. Heavenly-Opportunity knows the exact location of over 30,000 named places (including mountains and lakes, as well as over 500 national parks and monuments, wildlife refuges, and recreation areas), calculates the magnetic declination so you don't have to adjust your compass, knows when it is Daylight Saving Time (in the US), and estimates the duration of twilight. Heavenly-Opportunity *almost* replaces luck. Try it and see!

*Romeo. Lady, by yonder blessed moon I vow,  
That tips with silver all these fruit tree tops—  
Juliet. O, swear not by the moon, th' inconstant moon,  
That monthly changes in her circled orb,  
Lest that thy love prove likewise variable.  
– William Shakespeare*

## 1.2 Quick Start

*The only thing as good as watching a sunset is watching a sunrise in reverse.*  
– Edgar Allen Poe

If you have a previous Windows version of Heavenly-Opportunity installed on your computer, please uninstall it using your *Control Panel | Add/Remove Programs* feature. This removal will not delete any Heavenly-Opportunity data files you may have created in your directory – but this might be a good time to make a backup anyway!

If you have been sent a CD or floppy disk containing Heavenly-Opportunity, double-click on the SETUP application on the disk. This will install Heavenly-Opportunity for you. During installation, you may be asked to re-boot your computer. If so, please do as advised and then again perform the installation procedure.

## 1.3 What You Will Need

*We the globe can compass soon,  
Swifter than the wandering moon.* – William Shakespeare

In addition to a computer running Microsoft Windows™, to get the most out of this program you will need a compass to help use program features related to the direction of sun and moon rises and sets. Your compass need not be fancy, but it must have degrees clearly marked on the perimeter of the bezel (the turnable dial) and a line-of-sight mark of some sort. You must also have an elementary knowledge of how to use your compass in the field or in conjunction with a map. I have found that a luminous dial is useful in the pre-dawn hours and a "notch" style sighting capability can increase one's accuracy.

Your compass does not need to have adjustable *magnetic declination* because Heavenly-Opportunity will take care of that for you. You will, however need to know what *magnetic declination* means and how to take a *bearing*, both described in the **Glossary** section of this documentation. For some users, it may be an advantage to have a compass that has a built-in clinometer to measure angles above the horizon. For more accuracy, I recommend a dedicated clinometer.

It is worth repeating that to get an accurate compass reading, you must position the compass far from metallic objects such as metallic cameras, tripods, belt buckles, and automobiles. Out in the open is always the best bet. More than once I thought I had a program error when really it was a biased compass.

For more information about using compasses, please refer to:

<http://www.learn-orienteeing.org/old/lesson1.html> to get started and  
<http://www.learn-orienteeing.org/old/lesson2.html> for more about map work.

You will also need an accurate watch (I like to set mine with <http://www.time.gov>), and a good dose of judgment.

This documentation covers the basics of Heavenly-Opportunity. Photographic advice on exposure and similar topics must be gained elsewhere.

## 2. MAKING THE PROGRAM WORK FOR YOU

### 2.1 Before You Begin

I am tempted to jump right in to describe how to use Heavenly-Opportunity, but let me pause just briefly to say that you will get the best use from the program if you think about what you want from it first. Next time you go to the field, let your mind wander over the possibilities for sun and moon shots. Encourage your inner eye to start imagining “Wow, wouldn’t it look really great if I could only ...?” Take a compass and your watch with you, pay attention to what the sun and moon are doing, start to get an idea about how fast they move in the sky, and then pre-visualize the photo possibilities – the Heavenly-Opportunities. The more experienced you become at this, the more you will find that possibilities can become realities.

*Opportunities are like sunrise; if you wait too long you will miss them. – anon*

### 2.2 Program Navigation

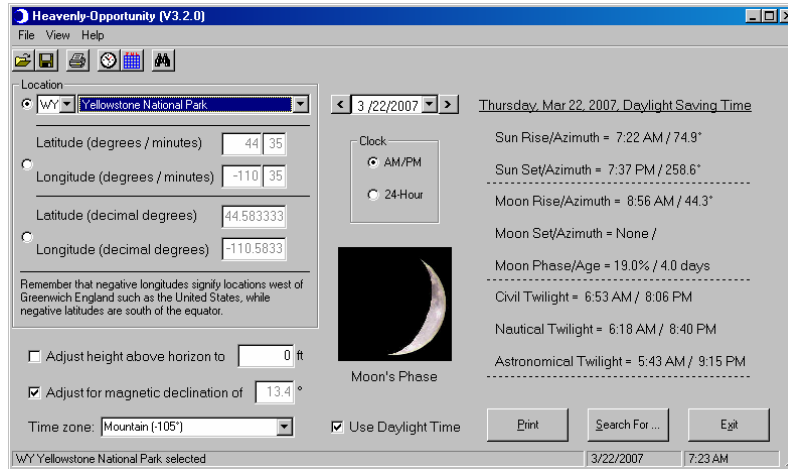
Start Heavenly-Opportunity just as you would any Windows program. Then, navigating Heavenly-Opportunity is easy because there are only three or four screens to understand. After the initial opening screen, the *Main* screen asks you for information to define your location and date of interest. Once these pieces of information are entered, you can move on to the *Search* screen where you tell Heavenly-Opportunity what conditions you are looking for. Finally, the *Results* screen displays the results of your search. You may wish to make multiple searches for a single location.



Tip: After you become familiar with Heavenly-Opportunity, see Section 3.3 for other ways to start the program.

## 2.3 The Main Screen

*If I can put one touch of rosy sunset into the life of any man or woman, I shall feel that I have worked with God.*  
– Gilbert K. Chesterton



If you have run Heavenly-Opportunity previously, it will open up the last-saved *favorite*. Then the main screen asks you for several simple things. First, select your desired photo location either from the dropdown (▼) lists for the state and location within the state. There are over 30,000 entries in the database. Choose your state first, then the location. Once you have selected your location by clicking on an entry in the list, Heavenly-Opportunity will automatically fill in the latitude, longitude, elevation, approximate time zone and Daylight Saving Time convention, and estimate your magnetic declination. [Note that when I say ‘state’ I also mean the District of Columbia (DC), Puerto Rico (PR) and Virgin Islands (VI). I have omitted other outlying US territories.]



Tip: If you wish, you may search for the location you are looking for by typing the first few characters of its name. Heavenly-Opportunity will then search for the first entry matching all characters you type. The search is done as characters are being typed, further refining the search. When you have found the location you are searching for, press the enter key or click with your mouse to select it. If you enter a backspace or wait more than a few seconds between the characters you type, the matching process will be reset and you may begin a different search. You may also navigate the list of locations using the *Page-up* or *Page-down* keys to move through the list of.

If you are not going to one of the places listed, latitude and longitude can be entered either as degrees and minutes (e.g., 40° 15’), or as decimal degrees (e.g., 40.25°). Remember that negative longitudes signify locations west of Greenwich England such as the United States, while negative latitudes are south of the equator. [For simplicity of programming, Heavenly-Opportunity does not accept latitudes north or south of the Arctic or Antarctic Circles (actually 65° instead of the true 66° 32’). This leaves out the (precarious) Arctic National Wildlife Refuge, among other locations.]

Next choose the day you wish to see. This will be ‘Today’ by default. You can choose the date either by editing the values in the box, use the calendar’s drop-down arrow (▼) and click on a



date, or by using the > or < buttons that advance or move back the day. You can also edit each of the date's fields by clicking on one and using the up and down arrows to adjust. Choose the clock you prefer, either AM/PM or 24-hour. If you wish, you can enter a height above the horizon for your location, but please see the discussion in the **Glossary** section on how to best use this advanced feature.

You may also update the time zone field if need be. As explained in the **Glossary**, time zone prediction is not 100% accurate. A map of US time zones may be viewed under *Help | View US Time Zones*. If in doubt as to time zone nuances, especially on an international scale, I would recommend referring to the web site <http://www.worldtimezone.com/index24.html>. The *Estimated magnetic declination* is printed in its box, but will always be gray to signify that it is not editable in this version of Heavenly-Opportunity.

Once you are satisfied with your location and other settings, the program will display the attributes for the sun, moon, and twilight conditions for the chosen day. (Note that the screen will not update the results until you complete an entry either by pressing the *Enter* key, click on a button, or move to another data entry location on the screen.) You may print this screen by pressing the *Print* button.

If this is all you need, press the *Exit* button to leave the program, but if you wish to search further – and this is the real value of Heavenly-Opportunity – then push the *Search For* button.

## 2.4 Typical Heavenly-Opportunity Searches

*To anticipate, not the sunrise and the dawn merely, but, if possible, Nature herself!*  
- Henry David Thoreau

Searching lets you look for combinations of events that make for the best photographs. The idea is to imagine where you want the sun and/or moon to be in your photograph and then set up the **Search** screen (see below) to find just those combinations that define the photos (timing, azimuth, phase) you are looking for. We'll go over some common examples below, but recognize that Heavenly-Opportunity will search the date range chosen trying to find one or more days that match ALL the criteria you have selected at the same time.

The **Search** screen looks complicated at first glance, but it is really quite simple. Criteria are arranged in groups: *Date Range*, *Moon Phase*, and *East and West Facing Criteria*. It is most often the case that you should make several simple searches rather than try to combine too many criteria at once. For example, it would be common to get one set of results using the 'East Facing Criteria' and one set using the 'West Facing Criteria'. However, you may mix and match as appropriate for your objective.

Searching between the beginning and ending dates is mandatory; you cannot unselect this search criterion.

When you have made your choices, press the *Display Results* button. When you have completed searching, press the *Close* button to return to the main screen.

### 2.4.1 Example 1: Get a Complete Table for the Next Year

*Know what you want to do, hold the thought firmly, and do every day what should be done, and every sunset will see you that much nearer to your goal. – Elbert Hubbard*

Probably the most common – and simplest – search you can perform is to merely tabulate the full set of times and azimuths for the sun and moon for your chosen location. This will be useful for places you visit often and you simply want to print and keep this record handy so that when you leave home on the spur of the moment, you have it with you. It is also useful just to get an idea of the full range of annual events, such as the range of azimuths for sun and moon rises and sets.

Heavenly-Opportunity automatically sets the search screen to list the daily events for the next year. It is easy to change the starting or ending dates by simply editing the dates in the boxes provided by either typing in new values or using the pull-down calendar feature that you have seen before.

### 2.4.2 Example 2: Good Conditions for Moonrise or Moonset

*As we walked homeward across the fields, the sun dropped and lay like a great golden globe in the low west. While it hung there, the moon rose in the east, as big as a cart-wheel, pale silver and streaked with rose colour, thin as a bubble or a ghost-moon. For five, perhaps ten minutes, the two luminaries confronted each other across the level land, resting on opposite edges of the world.*

*In that singular light every little tree and shock of wheat, every sunflower stalk and clump of snow-on-the-mountain, drew itself up high and pointed; the very clods and furrows in the fields seemed to stand up sharply. I felt the old pull of the earth, the solemn magic that comes out of those fields at nightfall. I wished I could be a little boy again, and that my way could end there. – Willa Cather*

Another favorite use for Heavenly-Opportunity is to catch the moon rising or setting in your landscape. Obviously you will want Heavenly-Opportunity to tell you when that will occur for your chosen location, but the best photos of moonrise/set occur during twilight when there is still enough light to see the landscape's features. I prefer the times immediately after sunset because you can get a more uniform exposure and show some of the moon's detail. I find that many people like to see the moon in the Belt of Venus, the colorful purple band that rings the horizon just after sunset. (You may be a morning person, so just adapt what I say for your conditions.)

The key to this search, then, is to ask Heavenly-Opportunity to seek days when moonrise is just after sunset. Like many features of Heavenly-Opportunity, this takes some judgment depending on the local lay of the land, but for simple conditions this is likely to be in the first 30 minutes after sunset. If you want the moon to be above the horizon a few diameters, you will need to allow for that, too. The moon appears to move through our sky at a rate of about  $14.4^\circ$  per hour (compared to the sun's average of  $15^\circ$ ) depending on the time of year. Another way to say this is that the moon moves one of its diameters about every three minutes.

Here is an additional twist that may be worth knowing. What if you want to find dates with moonrise between 5 and 10 minutes before sunset? Such a situation might arise for several reasons. For example, the eastern horizon may be formed by hills or buildings such that the moon would not be visible until some time after a level-horizon moonrise or sunset. Generally speaking, it is simply your desire to have a moonrise before sunset, or a moonset after sunrise, in order to have the moon at a desired vertical position at the desired time. To accomplish this, you would enter 10 minutes *before* and -5 minutes *after* sunset (5 minutes before and -10 minutes would also work). For moonsets between 55 and 60 minutes after sunrise (this is close to what you want to get a moonset over Mt. Whitney from the Alabama Hills), you would enter the criteria as -55 minutes before and 60 minutes after sunrise. (Solution courtesy of Jeff Conrad. Thank you Jeff!)



Tip: A helpful rule of thumb (or in this case *rule of fist*) is to hold your closed fist at arms length and note that the moon will move approximately two fists-worth per hour (if your arm/fist is like mine, measuring about  $8^\circ$ ). So, let's say that you want the moon to be one fist above the horizon just after sunset. This means that you want moonrise to be one-half hour before sunset so that when sunset occurs, the moon will be one fist up. Therefore, you tell Heavenly-Opportunity to find those days when this is true. Got it? If not, consult a clinometer and the **Daily Details** display to get a better handle on altitudes through the day.

### 2.4.3 Example 3: Moonrise or Moonset with a Specified Phase

*The spirit of God, like the sun, always gives all its light at once. The spirit of man resembles the pale moon, which has its phases, its absences and its returns, its lucidity*

*and its spots, its fullness and its disappearance, which borrows all its light from the rays of the sun, and which still dares to intercept them on occasion. – Victor Hugo*

Another simple search you can make is to find dates when the moon's phase is what you want in your photo. Heavenly-Opportunity reports the phase of the moon as a number between zero (new moon) and 100% (full moon). Many people like the full moon or close to it (phase > ~90%), but it is often nice to capture slivers (phase < ~10%). You will develop your own taste for what you want in your photos.



Tip: The fullest moon will always occur when the moonrise and sunset times (or moonset and sunrise times) are the most simultaneous. The opposite is also true. That is newest moons occur when moonrise and sunrise times (or moonset and sunset times) are the most simultaneous. This has implications for what makes a feasible search.

#### **2.4.4 Example 4: Sunrise or Sunset in a Specified Direction**

*The radiance was that of the full, setting, and blood-red moon, which now shone vividly through that once barely-discernible fissure .... – Edgar Allan Poe*

You may also want to catch the sun rising or setting immediately over some object, let's say a mountaintop. Or maybe you want to catch the sun's first or last rays on an object, perhaps that same mountaintop, but shining from a certain direction. Or maybe you are looking for one object to cast a shadow on another at sunrise or sunset, or not cast a shadow. Or maybe you are looking for excellent sidelighting (~45-80°), backlighting (~100-160°), or lighting at 90° to increase the saturation from a polarizing filter. It is pretty easy, with a bit of thought, to search for these conditions by knowing the sun's azimuth at sunrise or sunset. As always, there is considerable room for experimentation, but at least Heavenly-Opportunity lets you focus on the right days and angles to check out.

This type of search differs depending on whether you want to look towards the sun or want the sun to be behind you. If you want to look towards the sun, simply set Heavenly-Opportunity to choose the needed azimuth for sunrise or sunset. If you want the sun to cast a shadow in a certain direction simply add, or subtract, 180° from the direction of that shadow. For example, suppose you want the shadow from one object to strike another near sunset. Using your compass, site from the first object toward the second. Let's say that your compass shows you that this is 45°. This means that we want the sun to set at 45° + 180°, or 225°. If the direction you site is greater than 180°, subtract 180 instead of adding it. Or let's say that you want to get a reflection of color reflecting from a water surface, or the sun's reflection from a shiny object, just do the math. Note that the azimuth must always be between 0° and 360°.



Tip: Regardless of which direction you wish to face, always allow for a few degrees wiggle room. Searching for an exact azimuth, down to the degree, may result in no matches at all. Remember that you may have to change your camera's location to get exactly what you want because the azimuths of sunrises and sunsets will be constrained depending on your longitude. For example, here in Fort Collins, sunrise azimuths range from 47 to 111 degrees and sunset azimuths range from 229 to 292 degrees through the year. If you want an azimuth of 180°, you are out of luck.

### 2.4.5 Example 5: Combinations of the Above

*So stands his life to heaven as some fair sunlit tree against the western horizon, and by sunrise is planted on some eastern hill to glisten in the first rays of the dawn.*  
– Henry David Thoreau

I think you can generalize from the examples presented above. Obviously, choosing an azimuth search for moonrise or moonset works the same as for sunrise or sunset. It should also be apparent that you can search for multiple criteria by simply checking two or more elements at the same time. Remember that the likelihood of matching multiple criteria goes down as you add more. You may find that you need to relax some of your criteria a bit, but then that's Heavenly-Opportunity's strength – you can search and discover how close you can find the conditions you want for your photo.

However, don't automatically think that it is a bad thing to find only rare events. Sometimes the rare photo is the demanded photo. For example, you may wish to search for times when the moon is rising "on top of" the sun. I'm not talking about an eclipse – there are programs that aid in determining these rare events – but rather near-eclipses where the sun is just beginning to emerge but a sliver of the moon is immediately above the horizon. Or maybe you like taking 180° or more panoramas and want the sun and full moon just above the horizon opposite one another. Let your imagination run with the possibilities! Such an event may not occur in the next year, but it might two year's hence – weather permitting.

*Most events recorded in history are more remarkable than important, like eclipses of the sun and moon, by which all are attracted, but whose effects no one takes the trouble to calculate.* – Henry David Thoreau



Tip: Remember that several simple searches are better than one multiple-criteria search as long as you get what you need. In fact, when you visit a specific location, you will find that you really should explore multiple possibilities. For example, you will want to search for moon photos both at sunrise and sunset.

### 2.4.6 Example 6: Twilight Times

*The eastern light our spires touch at morning,  
The light that slants upon our western doors at evening,  
The twilight over stagnant pools at batflight,  
Moon light and star light, owl and moth light,  
Glow-worm glowlight on a grassblade.  
O Light Invisible, we worship Thee! – T.S. Eliot*

Though not an explicit search, many photographers like to work or experiment with photos during twilight times – looking for star trails and the like. Once you have identified when you will actually be in the field, use Heavenly-Opportunity to more closely examine the morning and evening twilight times when those opportunities exist. This will help you decide when to set up in the mornings and let your spouse know about when to expect you in the evenings.

## 2.5 The Results Screen

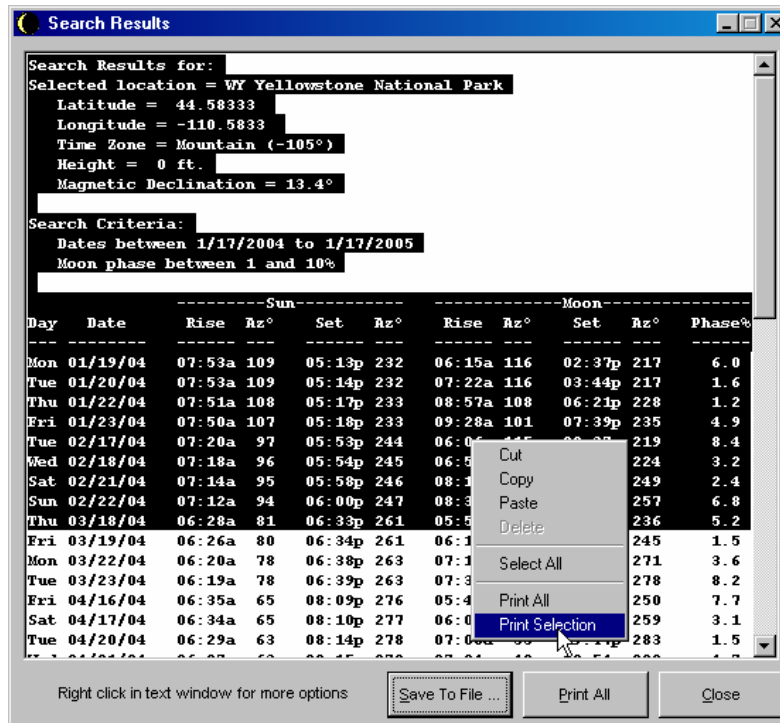
*The sun was just setting behind the edge of a wooded hill, so rich a sunset as would never have ended but for some reason unknown to men, and to be marked with brighter colors than ordinary in the scroll of time. Though the shadows of the hills were beginning to steal over the stream, the whole river valley undulated with mild light, purer and more memorable than the noon. For so day bids farewell even to solitary vales uninhabited by man. – Henry David Thoreau*

The **Results** screen is pretty straightforward. It presents a text file indicating the search criteria applied and a simplified table of what's happening on each day that matches your criteria. The last line in the window will tell you how many days matched those criteria. Using the buttons on the screen, you can save the results shown in the window to a text file or print the contents. If you use your mouse to block a portion of the file, you can right-click on the window (see above figure) to copy it for later pasting into another application such as your word processor. If you press the *Save To File* button, the program will initially open the installation folder as the saved file's destination; be sure to navigate to a new folder if you want to save your results elsewhere.

Note that the search screen may occasionally list *None* in the column for moonrise or moonset times. This is because there are indeed some days when this is true.

*I promise to be an excellent husband, but give me a wife who, like the moon, will not appear every day in my sky.*  
– Anton Pavlovich Chekhov

When you are through with the **Results** screen, press *Close* to return to the **Search** screen.



## 2.6 Viewing Daily Details

Probably the most frequent request that users have made regarding early versions of Heavenly-Opportunity had to do with supplying more information about the sun and moon's position throughout the day. Not all conjunctions of the sun or moon that a photographer wants are near or at the horizon. Sometimes you want to plan your shots with more finesse. **View | Daily Details** provides useful information on the hourly (or more frequent) locations of these spheres. I have not added the ability to search for these specific events, but may in a future version.

I admit that I have not really used this feature very much. I believe that it would best be used in conjunction with a "normal" search where you would estimate the time differences based on the "rule of fist" (see Section 2.4.2), clinometer, or experience. Azimuth differences will vary with the time of year and distance from the equator. Then, when you have identified a particular day of interest, use the **Daily Details** feature to refine your estimates. As always, experience will be a great teacher. Let me know what seems to work for you and what more you might need.

By the way, the algorithm used to compute the **Daily Details** is slightly different from the one used to compute moonrise and moonset altitudes and azimuths and results may differ very slightly.

## 2.7 Viewing the Monthly Almanac

This feature provides an "Almanac" much like the one given monthly in *Outdoor Photographer*® (OP) magazine, but with some improvements. This new feature always lists five Saturdays for the sunrise/sunset azimuths. That way one is covered regardless of whether there actually are five Saturdays in a month. The software also provides the top five "fullest" moonrise/moonset azimuths, including, as necessary, the last day of the *previous* month and the first day of the *next* month. Finally, it always lists the moon phases in chronological order, with blue moons as a separate line when appropriate. Choose the month and year you want (I recommend selecting one or the other and using the up/down arrows to change the value and the left/right arrows to move between month and year) and then press the **View** button.

Just as the instructions given in OP's "Almanac", you must find the nearest date in the top row and the latitude nearest your own in the left column. Where the two intersect, you'll find the true (or map) bearings for rise (R) and set (S), rounded to the nearest degree. When using a compass to find the spot on the horizon where the sun or moon will rise or set, obtain the magnetic declination (variation) for your area from Heavenly-Opportunity. If the declination is east, subtract it from the bearing listed below to obtain the magnetic compass bearing; if the declination is west, add it. The result is the correct compass bearing to use in the field.

Please note that this feature is for comparison with OP only. H-O's main screen can provide you with all this information -- even more precisely!



## 2.8 Saving Your Specific Photo Location and Parameters

*It was the most wild and desolate region we had camped in, where, if anywhere, one might expect to meet with befitting inhabitants, but I heard only the squeak of a nighthawk flitting over. The moon in her first quarter, in the fore part of the night, setting over the bare rocky hills garnished with tall, charred, and hollow stumps or shells of trees, served to reveal the desolation. – Henry David Thoreau*

Back on the Main Screen, you may choose to save your location and its parameters to a file for more rapid startup the next time you use Heavenly-Opportunity. For this task you may either press the Save button or choose *File | Save* (or *Save As*) from the menu. If you have selected a specific location from the drop-down location list, the selected name will be the default file name with an *HOP* extension – Heavenly-Opportunity Parameter file. If however you have just entered or changed the latitude or longitude, the default file name will be blank.

Once saved, the next time you run Heavenly-Opportunity, you can pick the file from Heavenly-Opportunity's list of recently used files under the *File* menu. This should help when you need to remember the exact latitude and longitude it took you so long to find and type in before. Opening one of these saved parameter files also remembers the search criteria that were used previously, but Heavenly-Opportunity only remembers the last nine files used.

## 3. EVERYTHING ELSE YOU MAY WANT TO KNOW

*There is something haunting in the light of the moon; it has all the dispassionateness of a disembodied soul, and something of its inconceivable mystery. – Joseph Conrad*

As previously mentioned, this documentation covers the basics of Heavenly-Opportunity. Photographic advice on exposure and similar topics must be gained elsewhere.

### 3.1 Tips and Caveats

Programs like Heavenly-Opportunity can only approximate the real world. For example, times of actual sunrise and sunset are influenced daily by how light is refracted, or bent, as it passes through our atmosphere. Refraction depends on many things such as air temperature and relative humidity. Though Heavenly-Opportunity attempts to correct for atmospheric refraction *on average*, any given day may vary. In addition, uncertainties in computed times increase with latitude due to the shallowness of the angles at the horizon, observer height, and local topography. Within a few degrees of the poles, computed times may be quite unreliable. For these and many other reasons, one should treat Heavenly-Opportunity's predictions as close, but not exact.

There are many tools available on the Internet that perform calculations similar to Heavenly-Opportunity. If you try them, you will note that they often differ in their predictions by a few minutes or degrees; don't be surprised by these differences. Though I have stressed accuracy in program implementation, Heavenly-Opportunity strikes a balance between accuracy and simplicity.



Finally, I must admit to a small bug that I have yet to slay. Occasionally Heavenly-Opportunity incorrectly predicts days when the moon fails to rise or set. There are certainly days for which this occurrence is real, as the moon can either be continuously above the horizon or continuously below, and such days increase in frequency with increasing latitude. However, the program can predict such an event in error. Errors I have noticed are usually, but not always, the last in the series of these events and always seem to occur when the time of rise or set would have been shortly after midnight. Fortunately, there are few opportunities for the kinds of photographs Heavenly-Opportunity is trying to catch at this time of day in most latitudes, so it doesn't matter much. But I'm working on it and welcome your suggestions.

### 3.2 Hardware and Software Considerations

Heavenly-Opportunity works best with a screen resolution of at least 800 x 600. Some special font settings may not work as well as others. If in doubt, choose *small fonts*.

Some users with HP DeskJet or other printers may find that they get a blank page feed when they first start Heavenly-Opportunity. This may be remedied by changing the printer driver settings. Although each printer driver is unique, the general technique would be to select *Start/Settings/Printers* from your Windows task bar. Then right click your default printer driver and select *Properties/Details/Spool Settings*. Then choose the option for *Start printing after last page is spooled*.

### 3.3 Heavenly-Opportunity's Files

Heavenly-Opportunity's saved parameter files are stored with the file extension *HOP*. Any results you save manually will have a *TXT* extension by default.

The program must have the files *HO1.MDB* and *WWM.COF* in its folder to run. These files contain the location database and magnetic declination calculation parameters.

At run time, the program creates an additional file, *HOResults.txt*, that is the same as the contents of the **Results** or **Daily Details** screens.

You may find it to your advantage to create a Windows desktop shortcut icon for Heavenly-Opportunity. See your Windows manual or help files for more information on how to do this. Likewise, refer to your Windows manual for information on how to *uninstall* Heavenly-Opportunity. Normally, this function will be found in the *Control Panel* under *Add/Remove Programs*. Similarly, you may wish to "register" Heavenly-Opportunity's default parameter file extension, ".HOP", with Windows so that they are listed properly on your File Explorer screen. This is typically done in the Windows *Open With* dialog, accessed by right clicking on one of the .HOP files.



**Tip:** Once you let Windows know to associate HOP files with Heavenly-Opportunity, you can start the program simply by double-clicking on one of the HOP files in the directory where you have chosen to store them. This will start the program with the location stored in the HOP file.

Additional files are associated with the Help system.

### 3.4 Warning and Informational Messages

*The moon is a white strange world, great, white, soft-seeming globe in the night sky, and what she actually communicates to me across space I shall never fully know.*

– D.H. Lawrence

It has been my intent that all warning and information messages be self explanatory. Many run-time messages will appear in the status bar at the bottom of the main screen, but more serious conditions will pop-up for your information. Occasionally, however, Heavenly-Opportunity may encounter an unexpected condition and display a typical bizarre computer error message. I'd appreciate an e-mail from you with as careful a description of what led to the error as you can. Thanks.

### 3.5 Recent Changes to Heavenly-Opportunity

*The moving moon went up the sky,*

*And nowhere did abide;*

*Softly she was going up,*

*And a star or two beside. – Samuel Taylor Coleridge*

Version 3.3.0 (10/22/08) Fixed bug in daily details calculations related to leap years. Fix supplied by Jeff Conrad -- with many thanks!

Version 3.2.4 (07/12/08) Changed mailing address and copyright dates

Version 3.2.3 (01/30/08) Added tolerance to allow for a search of an 'exact' azimuth, time or phase of moon

Version 3.2.1 (07/02/07) Added "Ship to" address on order form

Version 3.2 (3/11/07) Updated timing of Daylight Saving Time and added toolbar buttons for the Almanac and Daily Details

Version 3.1.3 (03/19/06) Altered Indiana time zone boundaries to address new laws

Version 3.1.2 (10/20/05) Slightly reformatted daily details output and other minor changes

Version 3.1.1 (03/05/05) Fixed bugs in calculating time zone just east of Greenwich or if in odd user-defined meridian

Version 3.0 (1/15/05) Added View | Daily Details screen. Reworded some labels. Revised pricing.

Version 2.3.1 (8/04) H-O now contains a feature like Outdoor Photographer® magazine's Almanac. Minor updates added too.

Version 2.2.0 (3/04) Corrected bug in lat/long used on searches. This bug has not been in all previous versions. I do not know when it arose. You may need to re-create existing HOP files to be safe.

Version 2.1 (12/03) All new program start-up and selection of state and place to improve performance. H-O auto-loads the last saved favorite or allows opening from an HOP file. Added ability to not adjust magnetic declination. Corrected an error with height adjustment for sun times. Numerous cosmetic changes.

Version 1.5.3 (11/01/03) Improved printing characters. Extended number of files remembered from 5 to 9.

Version 1.5.2 (08/30/03) Retained date after search and changed default azimuth for rises and sets on search screen.  
Version 1.5.1 (07/18/03) Fixed problem with moon times in search routine, and fixed initial date in search routine.  
Version 1.5 (7/03/03) improved the ability to predict time zones and added a 'Use DST' check box.  
Version 1.4 (6/27/03) corrected a different problem with changing time zones on moon times; also added time zone map  
Version 1.3 (6/06/03) corrected a problem on the Print setup dialog  
Version 1.2 (3/23/03) corrected a problem with changing the estimated time zone.  
Version 1.1 (3/01/03) is the original public release.

## 4. MATERIAL FOR FURTHER LEARNING

### 4.1 Glossary

*After you understand the about the sun and the stars and the rotation of the earth, you may still miss the radiance of the sunset. – Alfred North Whitehead*

#### Altitude

The angle (in degrees) that the sun or moon is above (or below if negative) the horizon from the observer's point of view. Inaccuracies near the horizon result due to refraction of the light rays passing through the atmosphere.

#### Azimuth

*The Moon for all her light and grace  
Has never learned to know her place. – Robert Frost*

For our purposes, the azimuth is the angle measured eastward from Magnetic North along the horizon to those points where moonrise, moonset, sunrise, or sunset intersect the horizon. Magnetic North would have an azimuth of 0° on your compass, while due west would be 270°. Note that this definition, and the Heavenly-Opportunity program, assume the horizon is 'flat', i.e., that there are no hills or mountains.

Any significant topography will influence both the apparent time of rise or set and make a slight difference in the predicted azimuth of the event. Thus, minor adjustments may need to be made to accommodate those differences. For example, I live just east of the Rocky Mountains where 'sunset' occurs for me anywhere from 10 to 20 minutes before the time Heavenly-Opportunity predicts, depending on the time of year, because foothills and mountains of varying heights are in the way. Note that this simply increases the duration of civil twilight, a potential benefit to twilight photographers.

The moon, unlike the sun, does not always rise at the same azimuth on the same day of the year. The moon, fickle as she is, follows a much more complicated path which repeats every

18.6 years. Amazingly, excavations have shown that prehistoric observers at Stonehenge apparently understood this, and much more. Now Heavenly-Opportunity returns us to our roots.

Heavenly-Opportunity accepts azimuths in the range of 0 to 360°, but remember that azimuths will be naturally constrained given your location on the earth's surface.

### Bearing

*Part of a moon was falling down the west,  
Dragging the whole sky with it to the hills.  
Its light poured softly in her lap. She saw  
And spread her apron to it. – Robert Frost*

For our purposes, a bearing is measure of the angle towards which you wish to photograph. Like *azimuth*, it is measured from Magnetic North clockwise around the horizon. Thus, due North would have a bearing of 0° and due East would be 90°. Normally, you would measure the bearing by pointing your compass's *direction of travel arrow* or *sighting line* toward your target and then swivel the dial until the magnet needle is aligned with the North sign on the dial. The bearing is then read from the dial at the direction of travel arrow.

### The Belt of Venus

*The grand show is eternal. It is always sunrise somewhere.  
– John Muir*

As a photographer, you have likely noticed that when the sun sets, the earth's shadow rises on the opposite horizon; the opposite happens at sunrise. Given an essentially cloudless twilight, a slice of the atmosphere above the horizon appears slightly pink. Called the Belt of Venus, this band is sandwiched between the Earth's shadow (below) and ordinary blue sky (above). In the Belt of Venus, the atmosphere reflects light from the setting (or rising) sun which appears more reddish. The moon caught in the Belt of Venus can be a colorful picture.

### Dates and Times (Format)

*Lost, yesterday, somewhere between sunrise and sunset, two golden hours, each set  
with sixty diamond minutes. No reward is offered for they are gone forever. – Horace  
Mann*

Heavenly-Opportunity accepts dates in the range from 1/1/1900 to 12/31/2099. I have not tested the program on computers having date or time formats that are different from the United States regional standard MM/DD/YYYY and HH:MM:SS.

## Daylight Saving Time/Standard Time

*Daylight saving time - why are they saving it and where do they keep it? – George Carlin*

The full story of Daylight Saving Time is a fun one, but well beyond our purposes here. Suffice it to say that Heavenly-Opportunity uses the convention commonly practiced in most parts of the United States of setting clocks one hour earlier in the fall so that both sunrise and sunset occur at a later hour, giving children more daylight for safety and other reasons. In the United States, as of 2007, Daylight Saving Time is observed in most places begin the second Sunday in March and ends the first Sunday in October. There are plenty of exceptions to the standard rules because this is a political, not scientific, decision. Heavenly-Opportunity knows about most of these exceptions in the US, but not all. If the program guesses incorrectly, you should have no problem changing the effective time zone for your particular situation.



Warning: Outside the US, Heavenly-Opportunity knows nothing about any special local Daylight Saving Time rules that may differ from the conventional standards, especially in the southern hemisphere, so adapt accordingly. Given enough interest, Daylight Saving Time could be implemented for the European community and, possibly, for the southern hemisphere.

P.S. on Daylight Saving Time. Each time we “spring forward” or “fall back” it is good to remember that we actually save a considerable amount of energy when we do so. Benjamin Franklin conceived of DST as a way to save candles.

## Height Above the Horizon

The height value on Heavenly-Opportunity’s main screen can be helpful, but only in selected circumstances and only if you know how to use it. The times of sunrise and sunset depend on the *relative* height you are trying to photograph. Alpenglow, that glowing mountaintop before sunrise or after sunset, is perhaps the most visible evidence of this you will see, and the spectacle that it is likely to be of most interest in using in Heavenly-Opportunity. The database that comes with Heavenly-Opportunity contains the elevation above mean sea level (AMSL) for almost all locations, including prominent mountains (listed as ‘summit’ or ‘pillar’) and some mountain ranges or ridges and, when used, can improve the accuracy of your time estimates. Consider the following example for how to best use this feature.

My home is in Fort Collins, Colorado, on the east side of the Rocky Mountains. I can see Longs Peak out my west window and can determine from Heavenly-Opportunity’s data base that it is 14,255 feet AMSL. Without the height adjustment, Heavenly-Opportunity says the sun will rise at that location today at 6:58 am. If I choose to use the height adjustment, Heavenly-Opportunity tells me that the sun should rise (and strike) Longs Peak at 6:45 a.m. But if I look out my window in the early morning light, I see the first sun on the peak at 6:50. Why was it a few minutes “late”? Well, Fort Collins is listed as 5,003 feet AMSL, and this is representative of a large portion of eastern Colorado, almost all the way to the Kansas state line, so the sun is still behind the earth at 6:45 a.m. However, if I subtract the two elevations ( $14255 - 5003 = 9252$ ) to calculate how much taller Longs Peak is than my vantage point, and use that height for Longs Peak, I get the time of sunrise as 6:48 a.m., close to what I observe from my window (but I’m not actually standing on top of the peak to look at the sun). So you see that about the only occasion you would use the *exact* elevation of a mountain would be when the sun would be seen rising or setting over the ocean. I hope you can generalize from this example.

Unfortunately, the elevations for many national parks, wildlife refuges and similar areas are missing from Heavenly-Opportunity's database. When missing, the elevation values are listed as zero. If you will provide me with better estimates of elevation for these areas (or any name changes that you come across for that matter), I will include them in Heavenly-Opportunity's database.

### Latitude

The combination of latitude and longitude is the way that we pinpoint a location on the earth's surface. The latitude of our location represents the angle north or south of the equator. The equator has a latitude of 0° and the North Pole, 90°. Measurements in the southern hemisphere are, by convention, negative; thus the South Pole is -90°. Fort Collins, Colorado, where I am located has a latitude of about 41°, meaning that it is almost halfway between the equator and the North Pole. Latitude may be found on most topographic or aeronautical maps, or on your GPS unit. Various books, such as GPS Waypoints or Delorme Gazetteers, may also be useful in finding or estimating latitude and longitude.

Heavenly-Opportunity accepts latitudes in the range of -65 to +65°.

### Longitude

The longitude of our location represents the angle measured east or west of the meridian running N-S through Greenwich, England. Measurements to the east are, by convention, positive and are negative to the west. Fort Collins, Colorado, where I am located, has a longitude of about -105°. Longitude may be found on most topographic or aeronautical maps or on your GPS unit. Various books, such as GPS Waypoints or Delorme Gazetteers, may also be useful in finding or estimating latitude and longitude.

Heavenly-Opportunity accepts longitudes in the range of -180 to +180°.

### Magnetic Declination

*It is morning, Senlin says, and in the morning  
When the light drips through the shutters like the dew,  
I arise, I face the sunrise,  
And do the things my fathers learned to do. – Conrad Aiken*

Sometimes called magnetic variation, the magnetic declination is the angle between True North (the North Pole) and Magnetic North. Some people think of this as "compass error." This angle arises in part because the location of magnetic north differs from the North Pole by over 1,000 miles. In the United States, magnetic declination can vary from 30° to the east of true north in Alaska to 20° to the west in Maine. The zero declination line runs approximately up the Mississippi River valley.

Heavenly-Opportunity automatically takes the magnetic declination into account when it reports sun and moon azimuths. This makes it very easy for you to take a compass reading in the field and be pretty sure that the sun or moon will rise or set where Heavenly-Opportunity says it will.

You must make an exception if you plan your photo using a map. In this case, you will need to adjust for the magnetic declination just as you would in any case involving a map. For example, assume you are looking at your map and decide that the bearing you want for your photo is 14° but the declination for this area is +10° west. (The declination will be printed on most detailed topographic and aeronautical maps). This means that your field bearing will be 24°. Conversely, if the declination is -10° east, your field bearing would be 4°. If you wish to use true north as indicated on your (computerized) map, then simply turn off Heavenly-Opportunity's azimuth adjustment.

As a footnote, magnetic declination changes slowly through time. Heavenly-Opportunity estimates the declination as of 2005. The changes are so slight that, for our purposes, they will be good for several years in the future. Newer versions of the program will update the declination estimation parameters as necessary.

### Moonrise/Moonset

*The moon is nothing  
But a circumambulating aphrodisiac  
Divinely subsidized to provoke the world  
Into a rising birth-rate. – Christopher Fry*

See **Glossary** for sunrise definition. Unlike the sun, note that on any given day, the moon may set before it rises.

### Phase of the Moon

*The moon is full tonight  
And hurts the eyes,  
It is so definite and bright. – Philip Larkin*

The phase of the moon is a measure of its illumination. A completely new moon has a phase of zero and a completely full moon has a phase of 100%. In-between, the moon will be either waxing or waning. Users of Heavenly-Opportunity will be interested in new moons to plan their photos of star trails.

### Sunrise/Sunset

*Once I saw a chimpanzee gaze at a particularly beautiful sunset for a full 15 minutes,  
watching the changing colors [and then] retire to the forest without picking a pawpaw for  
supper. – Adriaan Kortlandt*

This is time when the first (or last) of the sun's rays is visible at an ideal horizon, under ideal meteorological conditions. Said another way, sunrise or sunset refer to the times when the upper edge of the disk of the sun is on the horizon.

## Time Zone

Basically, the earth has been divided into 24 international time zones, each represented with a fixed longitudinal window, each roughly 15° wide. I say roughly because political boundaries occasionally result in significant deviations. The lower 48 states of the US are divided into four time zones: Eastern, Central, Mountain, and Pacific. Mainland Alaska has its time zone, as does Hawaii (along with the Aleutian Islands).

As with Daylight Saving Time, Heavenly-Opportunity simply determines the time zone most appropriate for the given state and longitude without worrying too much about their often jagged political boundaries or other special cases. I estimate that the program is right at least 95% of the time for supplied locations. Note, however, that the program is only about 75% accurate in predicting the time zone for locations entered using latitude and longitude, but when it is in error, you should find it relatively easy to adjust the zone as necessary. Note that you may need to adjust the time zone to correct for Daylight Saving Time when outside the United States.

Depending on where you look, time zones may be given different names. Heavenly-Opportunity uses Microsoft's naming convention for major time zones (look under *Time Zone* when setting your computer's clock). Like *longitude*, time zones are numbered east (positive) and west (negative) from Greenwich, which is zero by convention.

Heavenly-Opportunity accepts time zones in the range of -180 to +180°.

## Twilight

Twilight is defined as the pre-sunrise or post-sunset period of partial daylight caused by reflection and scattering of sunlight through the atmosphere. This can be an excellent time for photography. The further north or south of the equator we go, the longer twilight persists, until north of the Arctic Circle (or south of the Antarctic Circle) we may be in continuous twilight for long periods.

Various qualities of twilight have been standardized. Roughly, *civil twilight* is that period when normal activities (like photography) can continue more or less unhindered; many details are still plainly visible and as an added bonus, there are no shadows. When civil twilight ends, *Nautical twilight* begins, which means that there is still enough light to see ships in the gathering gloom; photographers can still make out shapes and silhouettes, but contrast is lacking. When nautical twilight ends, *Astronomical twilight* begins, when there is only starlight, though obviously the moon can add considerably to the picture. In fact, light from a full moon is 1,000 times that of the blackest night because of its reflected sunlight.

More technically, if the sun at noon has an illuminance of 103,000 lux, it will have 355 lux at the horizon, 4.3 lux at the end of civil twilight, and 0.001 lux during astronomical twilight. The full moon at its zenith will have 0.215 lux. Remember that a tiny bit of twilight on the horizon or moonlight in the sky may register brightly on film in long exposures. Extensive exposure bracketing is recommended.



## 4.2 Bibliography

*The moon looks  
On many brooks,  
The brook can see no moon but this. – Thomas Moore*

I have learned much and borrowed substantially from many non-copyrighted sources. The following were significant contributors to this project:

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U.S. Geological Survey Geographic Names Information System, <http://geonames.usgs.gov/>

U.S. Geological Survey Geomagnetism Group, <http://geomag.usgs.gov/>

Many, but not all, quotations came from <http://www.bartleby.com/>

## 4.3 Other Interesting Links

<http://antwrp.gsfc.nasa.gov/apod/ap011209.html>

<http://www.srrb.noaa.gov/highlights/sunrise/azel.html>

<http://aa.usno.navy.mil/data/>

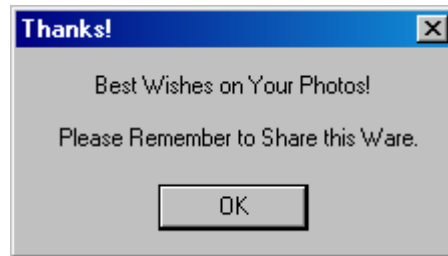
<http://aa.usno.navy.mil/data/docs/AltAz.html>

## 5. ACKNOWLEDGEMENTS

First, I must thank Janet Seeley who suffered my mutterings when things were not working, but shared my pleasures when the program's components finally fell into place. As a nature photographer and former technical editor, Allan Northcutt was very helpful in rounding out and fine tuning the documentation, offering much encouragement along the way. He was especially useful in his insistence that examples directly address the everyday needs of photographers. Jeff Conrad generously gave his time by posing thought-provoking questions, suggesting

changes to improve the program's accuracy, clarifying the program's wording, testing the software extensively, and helping to fix bugs, both mine and those originating from others; he's got some darn good photos too. I'd also like to thank Dan Laszlo for introducing me to the Belt of Venus. Jon Richards helped me with some mathematical functions. Mike MacDonald also helped test new features in Version 2.

The simulated moon images used on Heavenly-Opportunity's main screen display were captured from <http://www.ameritech.net/users/paulcarlisle/MoonCalendar.html>. The Stonehenge image, and some text, was adapted from <http://www.phoenix.org.nz/>. I am unaware of any copyright restrictions on using these images.



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