A LIVELY ELECTRONIC COMPENDIUM OF RESEARCH, NEWS, RESOURCES, AND OPINION

Astronomy Education Review

Volume 2, Sep 2003 - Jan 2004
Issue 2

Patrick O'Brian's Astronomy

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Posted: 11/25/03

The Astronomy Education Review, Issue 2, Volume 2:127-137, 2004

Abstract

With the opening in the fall of 2003 of the 20th Century Fox motion picture *Master and CommanderThe Far Side of the World*, starring Russell Crowe as Captain Jack Aubrey and Paul Belany as Jack's friend and colleague Stephen Maturin, a new generation will be introduced to the maritime novels of the late Patrick O'Brian. Here we explore some possibilities of using parts of these stories to foster student interest in astronomy and to introduce some of the astronomical and other resources on the Internet.

This material consists of three major sections. The first describes a number of scenes in the O'Brian books that contain astronomical references, and provides links to sites that contain additional information about the topics mentioned briefly in the novels. These links cover a wide range of topics: definitions of astronomical terms, certain mathematical expressions, geography, historical background, and more. The links are suitable for readers with differing levels of astronomical and general knowledge, though for certain groups, a teacher's support will be necessary.

Brief quotations from the novels illustrate that O'Brian was attuned to the state of astronomy in the early 1800s. The astronomy in O'Brian's books enters in a number of ways: off-hand remarks, discussions among the characters, mentions of lunar phases, and descriptions of the night sky, including planetary appearances. The second section of the paper shows, through examples based on the novels, how to use freeware to analyze some descriptions of the sky to see if such a configuration actually occurred at the time mentioned, and to determine a possible range of dates during which a particular incident might have taken place. Was Patrick O'Brian writing about a real or fictional world when he created these descriptions?

The third section of the text gives several problems drawn from situations in the novels that can be worked out with the techniques described in the second section of this paper. Answers are provided. These problems are best suited to more advanced students who already have a good understanding of such basic astronomical concepts as coordinates and time.

1. AUBREY AS AN ASTRONOMER

The late Patrick O'Brian wrote some 20 novels (http://www.wwnorton.com/pob/pobtitles.htm) related to the maritime adventures of Captain Jack Aubrey of His Majesty's Navy and his associate Stephen Maturin at the turn of the nineteenth century. The works have been most recently published by W. W. Norton (http://www.wwnorton.com/pob/bio.htm), where an appreciation of the author may be found.

The first title in the series is *Master and Commander*. The current motion picture combines this title with that of the 10th volume, *The Far Side of the World*, and places most of the action far from the opening scene in the former, which finds Jack Aubrey sitting in a music room in Port Mahon on the island of Minorca, watching Saturn rise as the recital continues. We'll return to this later.

Although the major characters are fictional, the stories are based on actual events as recorded in log books, letters, personal papers, and first-hand reports. Astronomy enters in two major ways: through conversations and through descriptions of celestial alignments and events. Considerations of Aubrey as an avid amateur astronomer set the stage and suggest that O'Brian had more than a passing interest in and knowlege of astronomy at this time.

The film does not deal with Jack as a telescope maker or with some of his other astronomical leanings because these are not directly connected to a plot of naval chases and battles. Moreover, in *Patrick O'Brian's Navy—The Illustrated Companion to Jack Aubrey's World* (O'Neill 2003, 46), there is no mention of astronomy among Jack's land-based activities, which include riding, fox hunting, and cricket, though Caroline Herschel is mentioned in a brief reference in the glossary. This gap is partially filled here.

Jack's special interest in astronomy appears in the opening pages of *The Mauritius Command* (1991), the third volume in the series. Among the first things that Stephen Maturin—natural scientist, physician, and spy—notices as he approaches Ashcroft Cottage, Jack's estate in the south of England, is that the little homemade observatory (http://cometman.com/DOME.html) has been moved a considerable distance from the house, and there, standing by the dome, is Captain Aubrey himself. In response to the question of why the move, Jack points out that from the current location, he can now view the shipping in an area that includes "the (Isle of) Wight (http://www.iwight.com/images/iow_maps/harbourmap.gif) and the Solent, the tip of Gosport (http://www.harbours.co.uk/solent1.html) and Spithead" (http://www.encyclopedia.com/html/s/Spithead.asp; 18). As a seafarer, he is particularly interested in the passage of ships, especially naval vessels, in and out of port.

And he is ecstatic about the operation of his new reflecting telescope (http://zebu.uoregon.edu/~js/glossary/reflecting_telescope.html), with its six-inch speculum that took him two months to grind and buff. Before the advent of quality glass disks, reflecting telescopes were created from a speculum or mirror figured and polished from a disk consisting of copper and tin, with traces of other substances such as antimony or arsenic to whiten it. But Jack had run into trouble, having taken a shade too much off the rim, and had very nearly given up when Miss Herschel, "admirable woman," he called her, came to his aid.

> Subsequently, the conversation is continued. "....tell me," said Stephen, "who is this Miss Herschel (http://www-gap.dcs.st-and.ac.uk./~history/Mathematicians/Herschel_Caroline.html) of whom you spoke...?"

"There is a woman you can talk to as one rational being to another. Ask her the measure of an arc whose cosine (http://www.ies.co.jp/math/java/trig/cosbox/cosbox.html) is nought, and instantly she replies pi (http://math.rice.edu/~pcmi/sphere/drg_txt.html) upon two; it's all there in her head. She is the sister of the great Mr Herschel (http://www.bath-preservation-trust.org.uk/museums/herschel/history.html)."

"The astronomer?" inquires Stephen.

Jack is especially concerned with various techniques of navigation (http://www.ion.org/satdiv/education.cfm). A major potential source of error in determining the altitude (http://www.astroleague.org/al/astrnote/astnot11.html)—angular height above the horizon—of a celestial body is the refraction (http://mintaka.sdsu.edu/GF/explain/atmos_refr/astr_refr.html) of light passing into the Earth's atmosphere that causes an object to be seen apparently closer to the overhead point than it actually is. In addition, he is experimenting with determining longitude (http://www.stats.uwaterloo.ca/~rwoldfor/papers/sci-method/paperrev/node3.html) from obervations of Jupiter's Galilean (http://www.jpl.nasa.gov/galileo/ganymede/discovery.html) satellites. Both of these are mentioned in his reply to Stephen.

"Just so. He honored me with the most judicious remarks on refraction when I addressed the Royal Society (http://www.royalsoc.ac.uk/), and that is how I came to know her. She had already read my paper on the Jovian moons....I go to see her every time she comes down to Newman's observatory, which is pretty often, and we sit there either sweeping for comets (http://www.uua.org/ga/ga98/jun27sweepmar.html) all night or talking about instruments. She and her brother must have made some hundreds in their time....it was she who showed me how to figure a speculum....And it is not mere theory: I have seen her walking round and round a post in Newman's stableyard for a good three hours without a break, putting the last touches to her mirror—it will never do to take your hand from the surface at that stage, you know—taking snuff from a saucer every hundred paces....she sings, too--hits the note plumb in the middle...."

"If she is Mr Herschel's sister, I presume she is a lady of a certain age?"

"Oh, yes, she must be sixty or so: she could never have come by so much knowledge of double stars (http://www.skywatch.co.za/doublestars/) in less. Sixty at least. Yes it is all one. Whenever I come home from a night with Miss Herschel there are wry looks, a tolerably frigid welcome."

Caroline Herschel was not precisely a close neighbor. She would have been living at this time in Slough (http://www.slough.gov.uk/businessandwork/map_popup.asp), some 10 miles north of the current Heathrow Airport and at quite a distance from Aubrey's south coastal home. She must have been an occasional visitor, however, as his wife Sophie laments, "I do so want him to be happy. I have tried to learn astronomy, like that Miss Herschel he is always talking about, and who treats me as though I were a child; but it is no use—I still cannot understand whyVenus (http://www.solarviews.com/eng/venus.htm) changes shape" (67).

Poor Sophie, still stuck in pre-Copernican (http://www.sca.org.au/castellum/copmap.htm) times. One wonders whether Jack tried to show her with diagrams (http://www.physics.ucla.edu/~huffman/venus.htm).

Other instances of O'Brian's acquaintance with astronomy in the early 1800s includes the following dialogue from *Master and Commander*. Jack and Stephen are cruising in the Mediterranean (http://daac.gsfc.nasa.gov/CAMPAIGN_DOCS/OCDST/ocdst_mediterranean.html):

> "A very fine landfall, Mr Marshall," said Jack, coming down from the top, where he had been scrutinizing the cape through his glass. "The Astronomer Royal (http://members.tripod.com/~UpSky2/ARs.html) could not have done better."
>
> "Thank you, sir, thank you," said the master, who had indeed taken a most painstaking series of lunars, as well as the usual observations to fix the sloop's position. (200)

Nevil Maskelyne (http://www.pinetreeweb.com/bp-nevil-maskelyne.htm) was Astronomer Royal in 1800, the year in which this story starts. On his way to St. Helena (http://www.sainthelena.gov.sh/other/images/new_page_1.htm) to observe the 1761 transit of Venus (http://venus-transit.de/), he had developed methods of determining longitude from measures of the Moon that competed with those based on Jupiter's satellites. His lunar tables remained a useful navigational aid for many years. Yes, the Astronomer Royal would have made a good landfall from "lunars."

Incidentally, the next opportunity to view a transit of Venus (http://www.eso.org/outreach/eduoff/vt-2004/vt-faq.html) is June 8, 2004.

A final illustration of O'Brian's astronomical knowledge comes from *The Ionian Mission* (1992), where Jack is trying to explain a recent exceptionally high tide to Sophie:

> "Here is the moon at her perigee (http://www.webopedia.com/TERM/P/Perigee.html), in syzygy (http://www.worldwidewords.org/weirdwords/ww-syz1.htm), and near the equator (http://geography.about.com/library/misc/blequator.htm), as I showed you last night, and you smoked it directly, did you not?"
>
> "Oh, perfectly my dear," said Sophie looking wild....
>
> "....And a full-blown spring tide (http://yahooligan.com/reference/dictionary/illus/sptide.html) at that..." (24).
>
> Yes, the tide will be highest when the Moon at either full or new phase is nearest the Earth.

2. SKY CONFIGURATIONS

Because Patrick O'Brian seemed to have more than a passing familiarity with astronomy at the times these books described, it seemed reasonable to check on some of his descriptions of sky configurations. Were the alignments of planets, their locations in constellations, their risings and settings (http://aa.usno.navy.mil/faq/docs/RST_defs.html) appropriate for the time, or were they products of the author's imagination?

Consider, for instance, the evening that Jack and Stephen talked about Caroline Herschel. Jack hoped the night would be as clear as the day had been (*Mauritius Command*):

> "I will show you such a double star in Andromeda, less than a second of arc (http://mathworld.wolfram.com/ArcSecond.html) apart!" (19)

Maybe he was referring to that glorious pair, a bright red star and a fainter blue one that comprise Almach (http://www.starlore.net/almach.htm) or gamma Andromedae. If so, he was a little off on their separation. But he continued, "We will have to sit up until three this morning before I can show you Jupiter" (19).

Is there a suitable range of dates that fit Jupiter (http://www.solarviews.com/eng/jupiter.htm) being viewed at about 3:00 a.m. local time from the location of Ashcroft Cottage? What do we need to know to answer this question? To begin, let's consider where we can find information about Jupiter's position in the night sky. An ephemeris gives the location of a celestial object at a particular time. There are books, tables, and several programs available over the Internet because many people, including navigators, planet watchers, astronomy buffs, and casters of horoscopes, like to know where comets (http://seds.lpl.arizona.edu/nineplanets/nineplanets/comets.html), minor planets (http://cfa-www.harvard.edu/iau/mpc.html), the Sun, and the Moon may be found against the stellar background on a particular date at a certain time. Probably the easiest of these programs to use is from Russia's Sternberg Astronomical Institute, which provides an ephemeris (http://infra.sai.msu.ru/ephemeris/) for the Sun, Moon, and major planets:

- Select the object from a pull-down menu (click on ephemeris).
- Type in the year, month, and day, using the decimal part of the latter for hours.
- Hit the submit key and read the result in celestial coordinates that enable you to locate an object on a sky chart. You will have to look elsewhere to see if it is visible at your location.

A listing of programs currently available commercially as shareware or freeware for many different formats may be found under Planetarium Software (http://www.seds.org/billa/astrosoftware.html). In what follows, results will be based on the free Web-based program *Sky View Cafe*, and a program from France that is not listed. Commercial software and others of these programs may do the job equally as well or even better, but a thorough evaluation has not been undertaken. (Of little use here, however, is Jet Propulsion Laboratory's HORIZONS system because it does not permit calculations as far back in time as those we will make.)

Now, back to Ashcroft Cottage. The target is Jupiter (http://seds.lpl.arizona.edu/nineplanets/nineplanets/jupiter.html). Our location is southern England, not very far from the Greenwich Observatory (http://www.rog.nmm.ac.uk), so we'll use that spot where the local time equals Greenwich Mean Time (http://greenwichmeantime.com). The major question is: What time of year should we consider? Earlier in the story, one reads that Stephen had approached the Cottage through a quagmire caused by heavy autumnal rains. This suggests a period that includes October and November. But what about the year? In his preface, O'Brian notes that the campaign to the island of Mauritius is factual. And according to an island history (http://ncb.intnet.mu/govt/history.htm), the British took over rule in 1810. Thus, because Jack and Stephen were involved in this campaign, their meeting at

Ashcroft Cottage must have been in 1809 which, incidentally, would have placed Caroline Herschel's age at about 60 years, as she was born in 1750. To get a feel for what we may find, let's take Nov 1, 1809, as one date, and Nov 1, 1808, for another. We'll look for the time of day that Jupiter will be highest in the sky, crossing the celestial meridian (http://star-www.st-and.ac.uk/~fv/webnotes/chapter4.htm) or at transit.

- Open *Sky View Cafe* (http://skyviewcafe.com/index.php). If the program does not appear, you may have to update your browser for the appropriate java script. Assuming that everything works, the applet should load after a brief interval. This program is free for use on the Internet. A standalone version, available as shareware, may be downloaded and provides faster access and more details. Be sure to read the listed *Quick Tips* and the *Help* page.
- On the right, set the *Time Zone* to UT (GMT) with the pull-down menu.
- Click on *Find*, look for Greenwich, GBR, and press Enter. The position will be given in terms of the coordinates (latitude and longitude [http://www.worldatlas.com/aatlas/imageg.htm]); the window should show a latitude of about 51.5 degrees and longitude of zero, because the meridian through Greenwich represents the origin from which longitudes are measured.
- Under *options*, choose a 90-degree span for the horizon, and under *Show Names*, click on planets.
- At the top, set the date to 1809-11-01.
- Now, above *Previous/Next Event*, pull down *transit* in the first box and *of Jupiter* in the second.
- Click on the blue arrow to find the time of transit on Ocober 31, and click on the right arrow to find a transit time of 22:23 for November 1. If your display is centered on South, Jupiter should appear near the top of the box. By clicking on the appropriate arrow, we can follow the time Jupiter transits for as many days as desired. The conclusion that we can draw is that Jupiter is high in the sky before midnight during the fall of 1809; there is no need to wait until 3:00 a.m. for viewing. Change the year to 1808 and find that the time of transit is 19:58 on November 1; by 3:00 a.m., Jupiter will be pretty low.

The second program is Lever, Coucher et Passage au Meridien des Corps du Systeme Solair (http://www.bdl.fr/cgi-bin/levcou.cgi) from the Bureau of Longitudes at the Observatory of Paris. Although the directions for this program that calculates the rise, set, and meridian passage of Solar System bodies are in French, the site is not difficult to use. When you open the program, the left draw-down panel contains information about usage—basically, risings, transits, and settings of the Sun, Moon, major planets, and numerous asteroids (which do not concern us) for any geographic location and for a single date or for a period of up to 999 days within the interval December 9, 1599, to June 24, 2191. Universal time is used throughout. There are additional details that are not important for present purposes.

- On the right side, one enters the data for the calculation: the year, month, day to start from; the number of dates from 1 to 999 to be used in the calculation; the particular object selected from the draw-down list; and a geographic location selected from among locales in France, other countries, observatories, or other places. If a real boner is made in entering the year, such as adding an extra digit, when the calculate button is pushed, a warning "Annee non valide" (year not valid) will appear. Be sure that the windows in which these numbers are entered are clear of prior entries.
- Begin by entering 1809, 11, 1 for the date, 1 for the number of dates, Jupiter for the target, and Observatoires for the location.
- In the *options* box, click on *Nord* for the direction of azimuth (http://curious.astro.cornell.edu/question.php?number=113), then select *visible pheonmena*, the right button.

- The third line allows calculations of the times of civil, nautical, and astronomical twilights (http://scienceworld.wolfram.com/astronomy/Twilight.html) pertaining to the rising and setting of the Sun. Leave it blank.
- Mark the *final box* if you desire to have results appear in a separate window. Now click the left *Calcul* button. A new box should show on the left of your screen asking you to select the observatory from the list.
- Highlight *Greenwich* and click on the *Calcul* button at the bottom of the list. Another window appears with the name and location of the site at the top. This is followed by a note that Jupiter is the body involved. Ignore the next items, which apply only if you wish the results in legal French time. Only visible rising and settings are calculated. On the other hand, results for both upper or visible and lower or potentially invisible transits are given. Only objects such as circumpolar stars (http://en2.wikipedia.org/wiki/Circumpolar_star) are visible at lower transits. In the results box, the first three numbers in each line are the date. In the top line, the next set of numbers tells us that Jupiter rose at 15:52:18, 80.4 degrees east of north. Then we find that Jupiter had crossed the meridian earlier in the day at 10:25:14, some 32 degrees below the horizon and thus invisible to an observer at Greenwich. Now look at the second row. The time 22:23:03 is when Jupiter was visible crossing the meridian at an altitude of 43.17 degrees above the horizon. This result is in keeping with our prior one. The final group of numbers on the first line tells when and where Jupiter set on the night of November 1, not on the night in question, November 2. To find that time, we would have to add another day to the calculation.

If our projected dates are correct, there was no need to stay up until 3:00 a.m. at Ashcroft Cottage to see Jupiter. In this case, O'Brian's sky appears fictional.

With the preceding as background, let's turn to some other scenes. Could they have existed in reality, or were they fiction? This is just a sampling—many more could be uncovered.

3. FACT OR FICTION

There is a history in astronomy of dating events by astronomical means. A battle between the Lydians and the Medes (http://www.ancientanatolia.com/historical/lydian_period.htm) was halted when the combatants were suddenly overwhelmed by a total eclipse of the Sun (http://www.mreclipse.com/Special/SEprimer.html). Centuries later, a precise date could be given to this event because one could calculate the narrow track along which an eclipse would be seen as total. From their part of the world, those fighters viewed the eclipse of May 28, -584 (585 B.C.) (http://sunearth.gsfc.nasa.gov/eclipse/SEhistory/SEHistory.html). Let's see if a few incidents from various stories can be dated in a comparable fashion. In some of the following, you are asked to provide a single date or an interval of time over which the sky might have appeared as described at the given location. In other cases, can you determine whether an actual view of the sky is being described for the specified time and place? You should be quite familiar with the programs described in the second section before proceeding.

A. The opening scene of *Master and Commander* is in the music room of the Governor's mansion in Port Mahon on the island of Menorca (or Minorca; http://www.lonelyplanet.com/mapshells/europe/spain/spain.htm). On this April night in 1800, we read: "... Mrs Harte, the commandant's wife, went through a long and technically difficult piece on her harp. Jack Aubrey looked out of the long, elegant windows into the night: Saturn (http://seds.lpl.arizona.edu/nineplanets/nineplanets/saturn.html) was rising in the south-south-east, a

glowing ball in the Minorcan sky" (9). Fact or fiction?

B. Later in the same story, while cruising in waters near latitude 42 degrees north and longitude 4 degrees east, another ship is spotted (158). Regulus (http://www.astro.uiuc.edu/~kaler/sow/Regulus.html) is setting in the twilight sky and there will be no moon until 2:30. About what date might this have occurred?

C. Further along in the same story, another pursuit is under way early in the evening between the time Venus has set and the Pleiades (http://www.ras.ucalgary.ca/~gibson/pleiades/) rise (290). The ship is somewhere off Cape Bougaroun (http://www.traveljournals.net/explore/algeria/map/8377/cap_bougaroun.html) in North Africa. What was the approximate date of this action?

D. *The Fortune of War* covers various naval actions during the War of 1812 (http://www.multied.com/1812/index.html). Fairly early in the story, Jack is showing the southern sky to his midshipmen as they sail below the equator off the coast of Brazil (http://go.hrw.com/atlas/norm_htm/brazil.htm; 81). The young moon has set; Mars (http://seds.lpl.arizona.edu/nineplanets/nineplanets/mars.html) is visible, as is the Southern Cross (http://www.astro.wisc.edu/~dolan/constellations/constellations/Crux.html). Given that the War of 1812 has just begun, can you estimate when the sky might have appeared as described?
Hint: To narrow the choices, review a list of new moons (http://aa.usno.navy.mil/data/docs/MoonPhase.html) for 1813.

E. Later, in the same book, after a series of adventures and misadventures, Jack, Stephen, and a couple of others land in Boston, Massachusetts, as prisoners of war. Some time passes before a British frigate is sighted off the coast, blockading the harbor. Soon Jack and his buddies decide that the moment has come to try to escape. They sneak off in the dark in a stolen row boat. We read: "...the silence of the night was fading fast...Saturn had set, following the moon...and already there was lightening in the east" (273). They are rowing across Boston Harbor (http://www.nps.gov/boha/), thus it is probably not winter; the likely season is spring or summer. Is there an appropriate date when the sky might have appeared as described?

F. Once or twice, O'Brian lists dates and days of the week. For example, in *Post Captain*, Jack, who enjoys fox hunting, reads a newspaper announcement: "Mr Savile's hounds will meet at ten o'clock on Wednesday, the sixth of November 1802...that set him reminiscing" (15). What was the actual date of the first Wednesday in November 1802?

G. *The Thirteen Gun Salute* opens with Jack being appointed the captain of the *Diane*...."on this fifteenth day of May in the fifty-third year of His Majesty's (http://www.britannia.com/history/h6f.html) reign" (119). They set sail for Pulo Prabang in the South China Sea (http://www.eia.doe.gov/emeu/cabs/schina.html), where Jack mentions "Jupiter is in opposition (http://zebu.uoregon.edu/~js/ast121/lectures/lec03.html)..." (202). In what constellation was Jack likely looking?

H. A number of nautical terms, such as "beam", "starboard," and "larboard," occur below. One source for definitions is the Napoleon Guide (http://www.napoleonguide.com/navy_glossary.htm).

The year is 1815; Napoleon has escaped from the island of Elba (http://elba-on-line.com/elbaengl.html). As described in *The Hundred Days*, Jack is sailing along the coast of Spain off Cadiz in a southeasterly direction. The birder's paradise of Punta Secreta

(http://www.birdtours.co.uk/tripreports/Spain/costa5/secreta.htm) lies astern, and Tarifa (http://www.arrakis.es/~pvm/index.html), near the entrance to the Mediterranean, lies ahead. We read:

> No moon, but a most splendid wealth of stars—Orion (http://www.astro.wisc.edu/~dolan/constellations/constellations/Orion.html) in his glory, great Vega (http://www.astro.uiuc.edu/~kaler/sow/Vega.html) blazing on the larboard quarter and Deneb (http://www.astro.uiuc.edu/~kaler/sow/Deneb.html) beyond; a little forward of the beam, both bears (big and little[http://www.seds.org/Maps/Pics/ursaminor.gif]) and the Pole Star (http://www.astro.uiuc.edu/~kaler/sow/Polaris.html); Arcturus (http://www.astro.uiuc.edu/~kaler/sow/Arcturus.html) and Spica (http://www.astro.uiuc.edu/~kaler/sow/Spica.html) on the starboard bow; and had the foresail not been in the way, Stephen would have seen Sirius (http://www.astro.uiuc.edu/~kaler/sow/Sirius.html), but he was shown Procyon (http://www.astro.uiuc.edu/~kaler/sow/Procyon.html). Then on the larboard bow Capella (http://www.astro.uiuc.edu/~kaler/sow/Capella.html), low down but still brilliant, and both Castor ((http://www.astro.uiuc.edu/~kaler/sow/Castor.html) and Pollux (http://www.astro.uiuc.edu/~kaler/sow/Pollux.html)—'Castor (http://einstein.stcloudstate.edu/Dome/constellns/castor.html) is a glorious double," said Jack, pointing them out to Stephen. "I must show him to you in my telescope when we are at home." (262)

About what time of year would the night sky have looked this way from their location?

I. *Desolation Island* begins with Jack trying to convince Stephen to join him in a voyage to the southern hemisphere. As a selling point, he raises the possibility of viewing a solar eclipse: ".... and in about a hundred and fifty east, twenty south, we should be in the full path of the eclipse, if only our times coincide" (21). The objective of this expedition is to rescue Captain William Bligh (http://www.lareau.org/bligh.html) of *Bounty* (http://www.tallshipbounty.org/) fame from those who have deposed him as governor of New South Wales (http://www.nsw.gov.au) during the Rum Rebellion (http://www.onwar.com/aced/data/alpha/australia1808.htm) of 1808. Had Jack and Stephen been at the suggested location at the appropriate time, would they have seen a solar eclipse?
Hint: Look for possible eclipses by visiting Fred Espenak's Eclipse Home Page (http://sunearth.gsfc.nasa.gov/eclipse/).

4. SOLUTIONS

A. The date is April 1800. The location is the island of Minorca or Menorca, which a map of Spain (http://go.hrw.com/atlas/norm_htm/spain.htm) shows to be at longitude 4 degrees east, latitude 40 degrees north. Open Lever, Coucher (http://www.bdl.fr/cgi-bin/levcou.cgi). Fill in the required information using a span of 30 days, and you should find that Saturn rises about noontime near the first of the month and earlier later in the month—hard to say what Jack was watching.

B. The location is 4 degrees east, 42 degrees north. Regulus is setting and the moon will not rise until 2:30 or thereabouts. The year is 1800. Probably the simplest way to proceed is to find dates on which the Moon will rise near 2:30. So, open Lever, Coucher (http://www.bdl.fr/cgi-bin/levcou.cgi) and investigate a 100-day span beginning June 1, 1800. You should find that moonrise is about 2:24 on June 20, nearly 2:30 on July 20, and some 10 minutes earlier on August 18. Turn now to Sky View Cafe

(http://skyviewcafe.com/index.php) and estimate when Regulus sets.

- Set the date to June 19, 1800, and the location as above. (Make sure you are on GMT.)
- Turn on the star designations and identify Regulus.
- Start at, say, 18:00, and click to change the hour. On June 19, Regulus does not set until darkness has begun. Do the same for July 19. Using the minute counter, you can watch Regulus disappear into the coming night. For the remaining date, it is clear that Regulus has set well before the Sun. Thus, July 19, 1800, appears to be a reasonable date for this episode.

C. Assume the previous location. As the tale progresses chronologically, we search for Venus settings after July 19, 1800. In early August, Venus sets with the Sun; over the next two months, Venus sets in the twilight, as shown by *Sky View Cafe*. To identify the group of stars called the Pleiades (http://www.seds.org/billa/twn/M45.html) in this program, go to show names and select "One Specific Object." Use the pull-down menu and click on *M* (for Messier 45 [http://www.obspm.fr/messier/xtra/history/CMessier.html]). By changing the day and time, you can investigate when the Pleiades rise. In early October, they appear about an hour after the Sun has set, thus the action was likely in late September or early October 1800.

D. During the first part of 1813, a reasonable guess for the year, new moons occur near the first of the month. We set *Sky View Cafe* for a location about 35 degrees west and 15 degrees south, and assume a time two hours earlier than GMT. By changing dates and times, we find that in early March 1813, Mars is rising while the Southern Cross is high in the sky. This is certainly a possibility.

E. The location is Boston Harbor at about 71 degrees west and 41 degrees, 29 minutes north. We assume spring or summer and will rule out 1813 for obvious reasons. Although a series of calculated times and dates of Saturn setting can be compared with those of the Moon, a more intuitive way is to use the planetarium program. Set the time for UT - 5 and begin in, say, May. Change dates and watch the motions of the Moon and Saturn. The tag end of July 1814 seems to fit the story of the Moon setting before Saturn, which disappears into a brightening sky.

F. O'Brian often associated a day with a date; here is one example. It is readily solved by consulting a calendar (http://www.earth.com/calendar) program. The actual date of the first Wednesday is November 3, 1802.

G. When a planet is in opposition, it rises as the Sun sets. Its location against the background of stars will be the same for all observers regardless of their locations. From what has been said, his Majesty was George III, who reigned from 1760, so Jack was appointed captain of the *Diane* on May 15, 1813. Open your planetarium program to a later date. Position yourself near the equator for easier viewing. Have the ecliptic outlined. Identify both the Sun and Jupiter and move them so that they separate by 180 degrees. Turn on the constellations' names. A possibility is Leo (http://www.seds.org/Maps/Stars_en/Fig/leo.html) in February 1814. Whoops! But remember that Jack is a fictional hero, and in separate stories might well be in two places at the same time.

H. Clearly, this is one for *Sky View Cafe*. It's 1815 and the vessel is at about 5 degrees west, 36 degrees north. Set the date to January 1, 1815, and watch the sky change month by month. Be sure you have the star names turned on. In early May 1815, the sky appears to be somewhat as O'Brian describes it, but Orion is hardly "in his glory," being partly below the horizon.

I. The most likely possibility for this eclipse is that of October 9, 1809, with mid-eclipse occurring for about a minute near 55 degrees south, 38 degrees east at 7:38 GMT. In *Sky View Cafe*, set the location as 150 degrees east, 20 degrees south, and the time at 1:00 GMT. Locate the Sun and the Moon in the sky. Change the time by small intervals and watch as the Sun and Moon become closer and closer together until they eventually set. Had Stephen and Jack been at this location on this date, they would likely have seen a partial eclipse from the quaterdeck of the *Leopard*.

Let's look at this in a bit more detail.

- Set the date for October 9, 1809, and the time 8:04 GMT.
- From the *Event* menu, select *Solar Eclipse*.
- From the toolbar click, on *map*. On this map, it will be night in the Americas and daylight from Africa to Australia. Dawn is coming to Iceland while the Sun is setting slightly to the east of Australia. If you were at the white circle to the northeast of the island of Madagascar, the Sun would be directly overhead at this instant. At the yellow circle, the Sun is totally eclipsed. Enter Jack's suggested coordinates: 20 degrees south, 150 degrees east, and another circle appears on the east coast of Australia. As you see at this time, Jack is quite far from the position of totality. You can put the Moon's shadow into motion by changing the time minute by minute to trace out the path along which the eclipse would be total.

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