How to Enter New Comets, Asteroids or Satellites into Starry Night

By Ken Munson

As anyone who's ever used Starry Night software to explore the sky and/or plan a night's observing session, one of its neatest features is that is has built into it an automatic update feature. As a minimum, every two weeks you can expect it to ask you if you want to download the latest comet/asteroid/satellite files from their website. In general, this works very well. However, I have found many occasions when the latest newly discovered comet or near-earth asteroid that is flying by is not contained in their automatic update feature. What can you do if you'd really like a chance to observe these objects but don't want to wait another two weeks? You can force an update but, if they haven't updated their website you're still out of luck. Or are you?

Since I am the impatient type and, thanks to my work, know a couple of things about orbits, I went looking and found some websites that can provide the information needed to enter the orbital parameters into Starry Night and do your own update. That way you know you have the newest comet discovery in your database and have a good chance of finding it.

One Easy Alternative

The first website I check out for new comets is:

http://cfa-www.harvard.edu/iau/Ephemerides/Comets/SoftwareComets.html

There is also a companion page just for asteroids with all the same information. However, the asteroid page seems more devoted to things that are much more difficult for the average amateur observer to find so I haven't used it very much:

http://cfa-www.harvard.edu/iau/Ephemerides/SoftwareEls.html

As the URL implies, it's a website devoted to providing ephemerides for comets. When you go to this webpage, you'll find a hand list of all the different software that they have quite nicely arranged to have the necessary information arranged so that you can simply plug the orbital parameters into whatever software you are using. The page listing looks like this:

Elements are currently available for the following packages:

- MPC format
- SkyMap (SkyMap Software)
- Guide (Project Pluto)
- xephem (E. Downey)
- Home Planet (J. Walker)
- MyStars! (Relative Data, Inc.)
- TheSky (Software Bisque)
- Starry Night (SiennaSoft)
- Deep Space (D. Chandler)
- PC-TCS (D. Harvey)
- Earth Centered Universe (Nova Astronomics)
- Dance of the Planets (ARC)
- MegaStar V4.x (E.L.B. Software)
- SkyChart III (Southern Stars Software)
- Voyager II (Carina Software)
- SkyTools (CapellaSoft)
- Autostar (Meade Instruments)

Information on the MPC's format is here. Information on the other formats may be located on the relevant home pages.

Clicking on the Starry Night (SiennaSoft) choice will bring you to the page where you get all the information you need. It looks like this:

NOTE: If viewing this file and it appears confused, make the window very wide!

The numbers are all in the proper format for easy use in Starry Night's orbit editor. Just click on the word Sun in the planet floater and then click on add. In the first window that appears select the comet as the type of object you want to add. Please see the manual for more information.

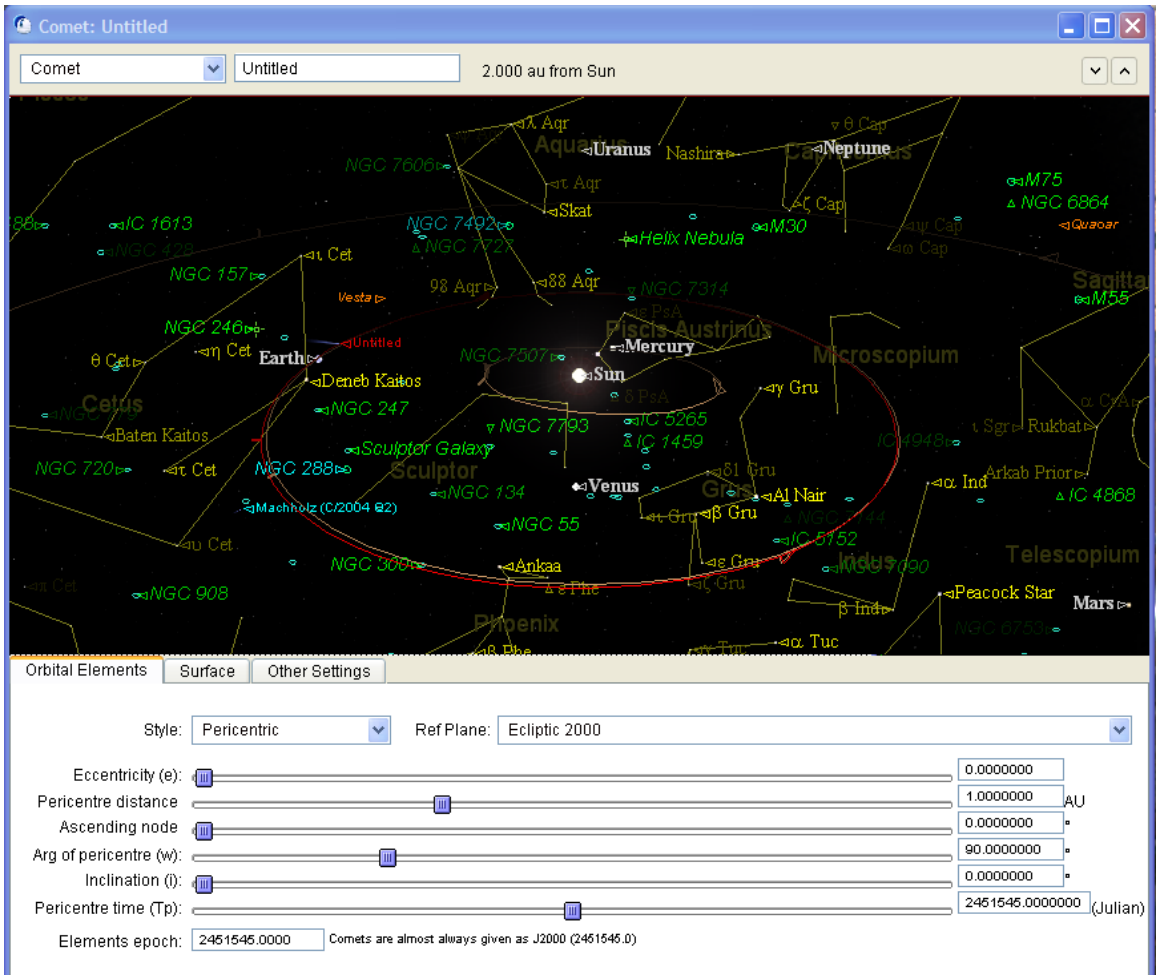
The orbital information should have the reference plane set at Ecliptic 2000 and the Style should be pericentric. Don't forget to use copy and paste to ease the input of the orbital data into Starry Night.

This file kindly prepared by the IAU Minor Planet Center & Central Bureau for Astronomical Telegrams.

Num	Name	Mag.	Diam	e	q	Node	w	i	Tp	Epoch	k	Desig
	Encke	11.5	0.0	0.847290	0.338648	334.5897	186.5083	11.7673	2453003.3848	2453400.5	15.0	2P
	Tempel	5.5	0.0	0.517580	1.506065	68.9434	178.8407	10.5294	2453556.8214	2453400.5	25.0	9P
	Tempel	5.0	0.0	0.535387	1.426861	117.8488	195.5585	12.0177	2453416.5384	2453400.5	25.0	10P
	Giacobini-Zinner	9.0	0.0	0.705662	1.037926	195.4302	172.5453	31.8108	2453554.2793	2453400.5	15.0	21P
	Neujmin	8.5	0.0	0.775383	1.551634	346.9861	346.9398	14.1916	2452635.8067	2453400.5	15.0	28P
	Schwassmann-Wachmann	4.0	0.0	0.044075	5.723424	312.7067	48.7097	9.3911	2453193.8544	2453400.5	10.0	29P
	Reinmuth	9.5	0.0	0.501509	1.879021	119.7604	13.2941	8.1292	2452632.6962	2453400.5	15.0	30P
	Schwassmann-Wachmann	5.0	0.0	0.193330	3.412325	114.2004	18.4350	4.5496	2452292.5212	2453400.5	20.0	31P
	Comas Sola	6.5	0.0	0.569268	1.833019	60.7949	45.8238	12.9273	2453461.8335	2453400.5	20.0	32P
	Whipple	8.5	0.0	0.258611	3.088434	182.3960	202.1925	9.9334	2452826.9619	2453400.5	15.0	36P
	Forbes	10.5	0.0	0.541514	1.572446	315.1109	329.2320	8.9586	2453584.2130	2453400.5	12.0	37P
	Oterma	5.0	0.0	0.243452	5.470144	331.5433	56.3189	1.9433	2452629.4820	2453400.5	15.0	39P
	Vaisala	5.5	0.0	0.632913	1.796247	134.7334	47.2006	11.5381	2453027.3973	2453400.5	30.0	40P
	Neujmin	13.0	0.0	0.585176	2.014800	150.3850	147.1575	3.9856	2453202.4446	2453400.5	15.0	42P
	Wolf-Harrington	8.0	0.0	0.544920	1.578525	254.6489	187.3363	18.5237	2453082.4421	2453400.5	15.0	43P
	Ashbrook-Jackson	1.0	0.0	0.340639	2.672818	358.5620	357.8951	13.5742	2454847.2168	2453400.5	28.0	47P

On this page will be a list of many comets by name and designation (e.g., 2001 Q4). Using the web browser's Find function, simply find the comet you're looking for. Once you've found it, then the question is, what, in all this information, do you need. Well, fortunately, on this website they've laid out everything (well, almost) in the order it needs to be entered in Starry Night.

In Starry Night, to enter a new solar system body, one has to get to the proper pull down menu. In an older version this was located in the Window/Planets pull-down. In newer versions, it is located as a line item under the File pull-down menu. The pull-down menu should take you to a subscreen that looks like:



A quick comparison of this Starry Night screen and the preceding webpage will show that they both have the same information in the same order. To enter the orbital parameters for a new comet, start with *e* (eccentricity) and copy and paste each line item for the comet into the corresponding box in Starry Night. The Diameter listed on the webpage is not used. The Magnitude parameter is actually entered into a box of the same name under the Other Setting menu.

Follow those steps, and check to make sure the numbers have been entered correctly and then your version of Starry Night will now have the newly discovered comet in its database. In the older versions (pre-4.0), you generally couldn't do a FIND on it but you could find it in the list of comets and then double-click on it. The other alternative to that was to close the program, saving the changes of the new object and then restart the software. From there it works like normal. The newer version, 4.0 and up can usually do a FIND on the newly entered comet right away.

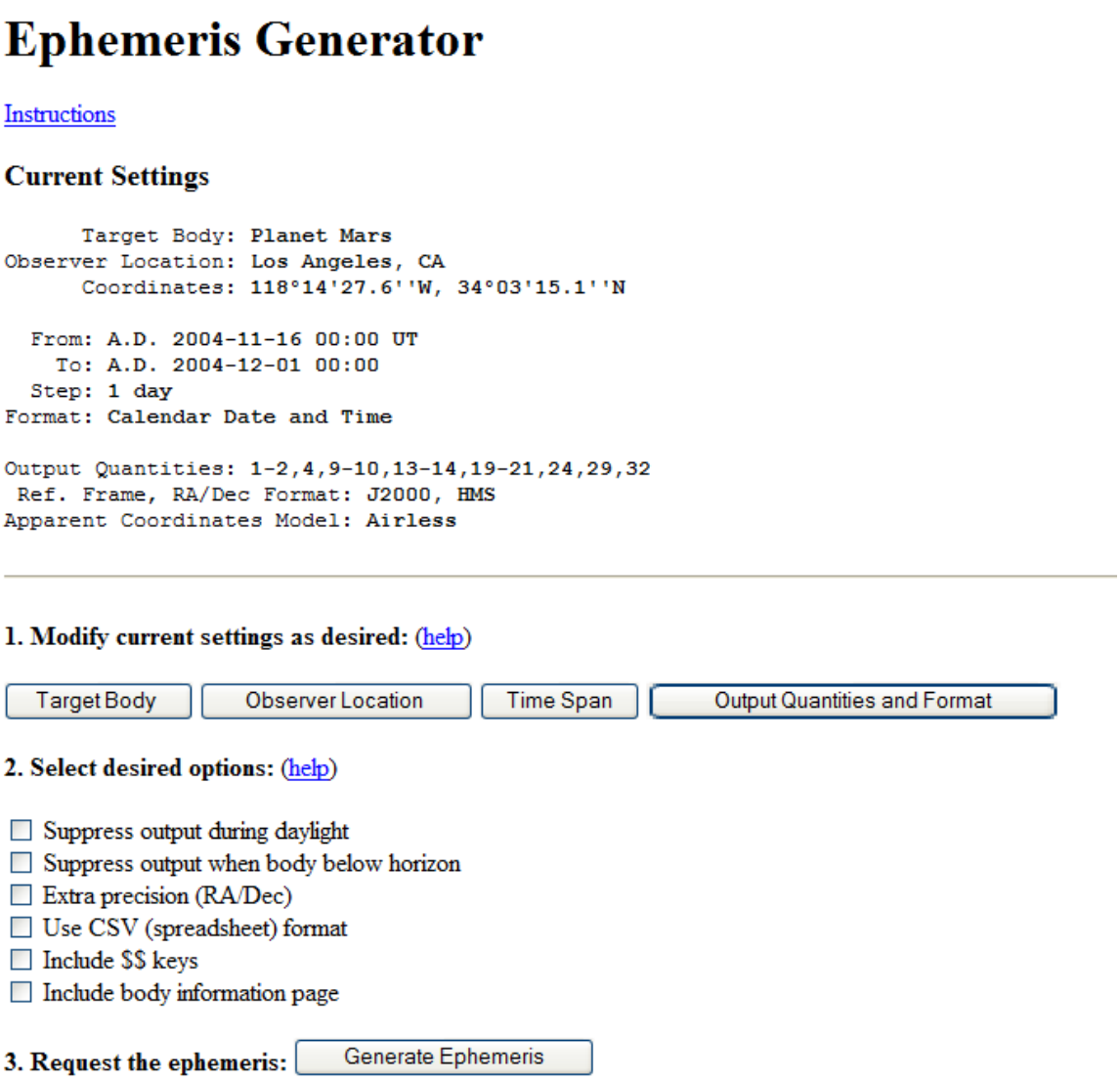
As a final check, one should check the positions in Starry Night for your new comet against the ephemeris listed in magazines like Astronomy or Sky & Telescope. It's a good idea to do a check just to make sure you don't get frustrated when you're out beyond the reach of the internet.

Another Alternative

On those rare occasions when even this website doesn't yet have a newly discovered comet or asteroid, there is yet another place to go find the orbital parameters. This is a website run by JPL which contains ephemerides for virtually every know object in the solar system. The website is:

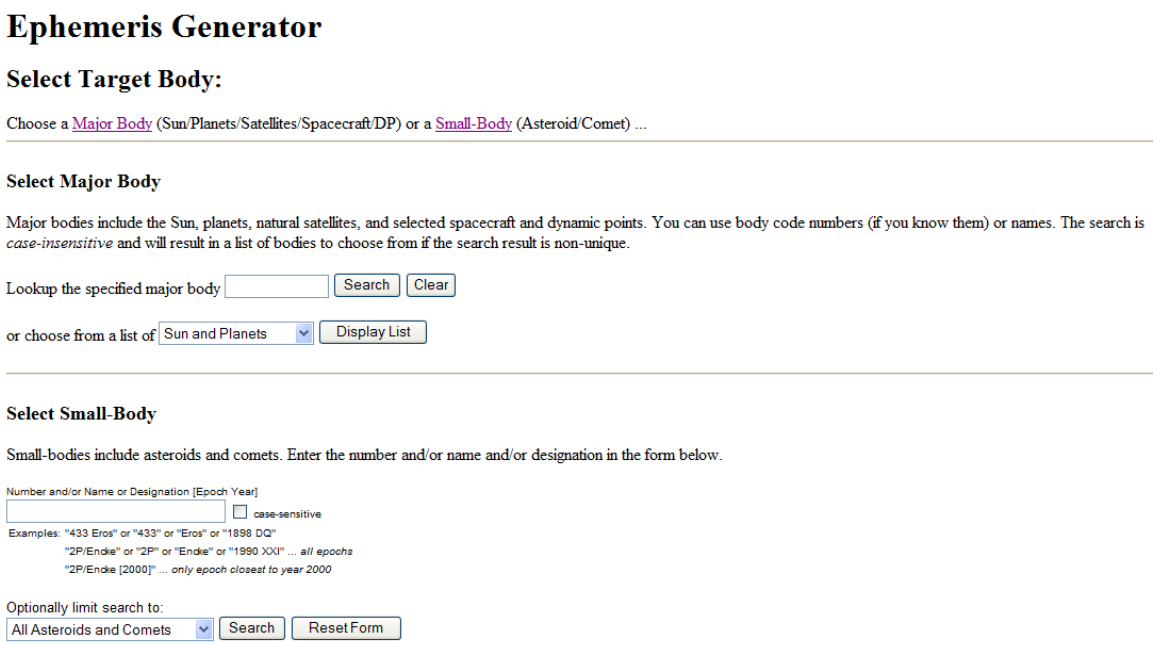
http://ssd.jpl.nasa.gov/cgi-bin/eph

Although not as user-friendly as the Harvard site, it's still a pretty easy site to find your way around on. Upon arriving at the first webpage, you'll see a page that looks like this:



This is basically it. You have four main choices: Target Body, Observer Location, Time Span and Output Quantities. As a general rule, you don't need to do anything with the Output Quantities. Just use the default.

The first thing to do is identify the Target Body. Click on the Target Body button and it'll take you to a second screen:

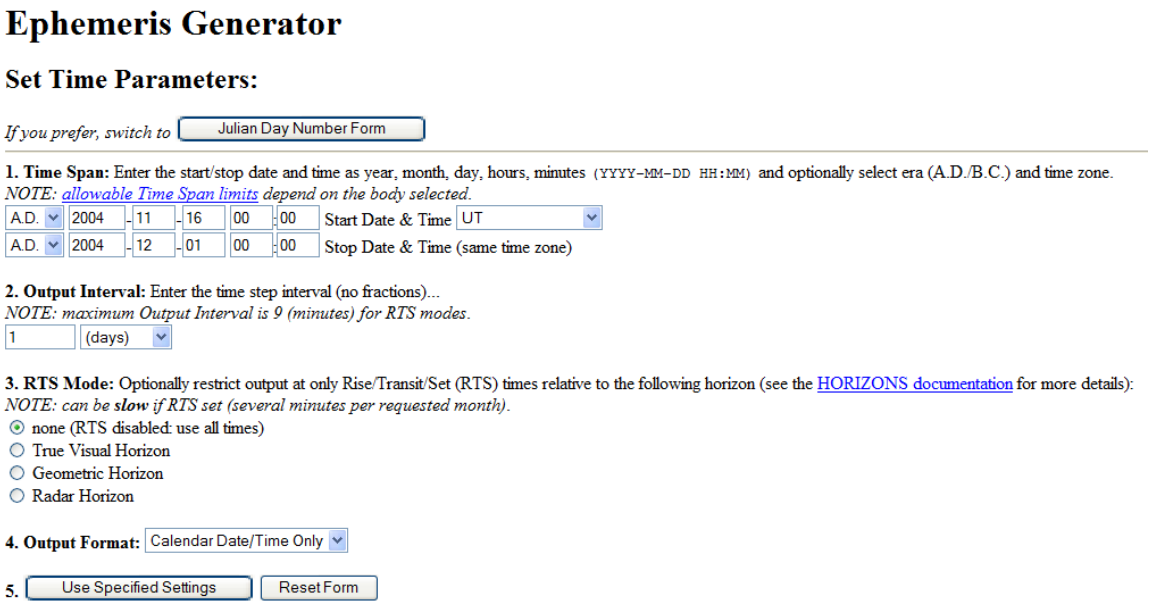


When working with comets and asteroids, the Select Small-Body section is what you need to use. Simply type in the name of the comet/asteroid as listed in the news or magazine (e.g., 2001 Q4, Halley, etc.) and click *Search* it'll search its database for the appropriate object. Once it finds the object, it will return to the previous page.

Now you have to tell it where you are observing from. If you're within 70 miles of downtown Los Angeles, you don't have to worry about this item. Beyond that you have three options: Lookup a Named Location, Choose from a List of Locations, or Giving the Latitude and Longitude and Altitude of your observing site. That last one will require the use of a GPS receiver or the use of an atlas where you can find the lat/lon of a nearby town or city.

Once you've entered your location via one of these methods, at the bottom of this page is a button "Use the Specified Location". Click on that and it'll take you back to the first page again.

The third item is the time span over which to generate an ephemeris. Since most people do their star gazing at night it's generally most useful to request nighttime hours. However, once can generate an ephemeris for as long a period as one wants. We'll deal with that in a bit. Clicking on the Time Span button takes you to another screen:



On the surface this looks like a fairly straightforward page. However, it defaults to Universal Time (see the UT in the box?). To enter the time span required, simply fill in the Year, Month, Date, Hour (and that's in 24-hour clock time) and Minute that you want to start and similarly for when you want to end. For those, like me, who hate having to make translations from UT to local time, clicking on the little arrow on the UT box, will give you a menu of all the time zones to choose from. Typically, here in California one would choose the PST zone. However, remember during the summer months of Daylight Savings Time, that you have to use the MST time zone!

The next thing to do is to select the object interval. Generally, 15 minute intervals is sufficient for most comets. Near-earth asteroids, which can be moving pretty fast, usually require 5 minute intervals. Simply enter the appropriate number, click on the arrow to select the interval (days, minutes, hours from the submenu).

Having done all that, there's no need to tamper with item 4. Just go to item 5 and click on the "Use Specified Settings". That will again, take you back to the first page.

Now that you've got all the pertinent data entered, it's about time to generate an ephemeris. Two final things: click on the boxes for 'Supress Output during Daylight' and 'Supress Output when Body Below the Horizon'. That'll prevent your wasting time trying to find something that you have no possible means of seeing for those two reasons. They come in handy if you've decided to do ephemerides for more than one night at a time.

Now it's time to click on 'Generate Ephemeris' and let the software do its thing.

When it's done, you'll be one a screen with a header that looks like:

Ephemeris Generator

Ephemeris Settings

```
      Target Body: Comet C/ASAS (2004 R2 = 2004 R2) [2004.67]
Observer Location: User Specified Location
      Coordinates: 118°14'27.6''W, 34°03'15.1''N

  From: A.D. 2004-11-16 00:00 UT
    To: A.D. 2004-12-01 00:00
  Step: 15 minute
Format: Calendar Date and Time

Output Quantities: 1-2,4,9-10,13-14,19-21,24,29,32
 Ref. Frame, RA/Dec Format: J2000, HMS
Apparent Coordinates Model: Airless
```

Below that header is a rather lengthy tabulation of all the various parameters that went into generating the ephemeris table that follows. The important information that is required for Starry Night (and other software) is this:

```
*******************************************************************************
Initial FK5/J2000.0 heliocentric ecliptic TWO-BODY elements (AU, DAYS, DEG):
  EPOCH=  2453276.5 != 2004-Sep-28.0000000 (CT)   Residual RMS= .94628
    EC= .9999999999999959  QR= .1128342205334107  TP= 2453286.39735378
    OM= 182.463914754938   W= 5.353539997602056   IN= 63.1739292513078
Comet physical & dynamic parameters (KM, SEC; A1,A2,A3=AU/d^2; DT=days):
    GM= n.a.               RAD= n.a.              A1= n.a.
    A2= n.a.               A3= n.a.               DT= n.a.
    M1= 11.5               M2= n.a.               k1= 10.
    k2= n.a.               PHCOF= n.a.
```

Although it looks different, this is the same information as was presented on the Harvard website, just not in the same order and with a couple of different abbreviations. Most of them are fairly straightforward

e = EC which is the eccentricity of the orbit
q = QR which is the pericentric distance of the orbit
Node = OM(ega) = which equals the ascending node of the orbit
w = W which is the Argument of Perigee of the orbit
i = IN which is the inclination of the orbit.
Tp = TP which is the time since the last time the object was at pericenter
and obviously
Epoch = EPOCH which is the point in time for which these parameters were created.

Once again, from here it's a matter of opening the new comet/asteroid input dialog window as shown before and entering the appropriate numbers in the appropriate slot in Starry Night.

The nice thing about using the JPL site is that it has two great advantages. The first is the ephemeris table that is listed below the orbital elements:

```
*****************************************************************************************************************************************************
 Date__(UT)__HR:MN     R.A._(ICRF/J2000.0)_DEC R.A.__(a-apparent)__DEC Azi_(a-appr)_Elev  T-mag  N-mag Illu% Ang-diam Ob-lon Ob-lat
*****************************************************************************************************************************************************

>..... Daylight Cut-off Requested .....<

 2004-Nov-16 01:00 C   19 21 36.68 +03 48 09.1 19 21 49.88 +03 48 40.6 218.5466  53.6181  12.62   n.a.  83.1     n.a.   n.a.   n.a.
 2004-Nov-16 01:15 C   19 21 40.12 +03 48 05.6 19 21 53.31 +03 48 37.1 223.7023  51.5752  12.63   n.a.  83.1     n.a.   n.a.   n.a.
 2004-Nov-16 01:30 N   19 21 43.55 +03 48 02.0 19 21 56.74 +03 48 33.5 228.4090  49.3391  12.63   n.a.  83.1     n.a.   n.a.   n.a.
 2004-Nov-16 01:45 N   19 21 46.98 +03 47 58.5 19 22 00.17 +03 48 30.0 232.7073  46.9410  12.63   n.a.  83.1     n.a.   n.a.   n.a.
 2004-Nov-16 02:00 A   19 21 50.41 +03 47 54.9 19 22 03.60 +03 48 26.5 236.6422  44.4077  12.63   n.a.  83.1     n.a.   n.a.   n.a.
 2004-Nov-16 02:15 A   19 21 53.84 +03 47 51.4 19 22 07.03 +03 48 22.9 240.2586  41.7619  12.63   n.a.  83.1     n.a.   n.a.   n.a.
 2004-Nov-16 02:30     19 21 57.27 +03 47 47.8 19 22 10.46 +03 48 19.4 243.5987  39.0226  12.63   n.a.  83.1     n.a.   n.a.   n.a.
 2004-Nov-16 02:45     19 22 00.70 +03 47 44.2 19 22 13.89 +03 48 15.9 246.7011  36.2057  12.63   n.a.  83.1     n.a.   n.a.   n.a.
 2004-Nov-16 03:00     19 22 04.13 +03 47 40.7 19 22 17.32 +03 48 12.3 249.6002  33.3245  12.63   n.a.  83.1     n.a.   n.a.   n.a.
 2004-Nov-16 03:15     19 22 07.56 +03 47 37.1 19 22 20.75 +03 48 08.8 252.3267  30.3901  12.64   n.a.  83.2     n.a.   n.a.   n.a.
 2004-Nov-16 03:30     19 22 10.99 +03 47 33.6 19 22 24.18 +03 48 05.3 254.9073  27.4120  12.64   n.a.  83.2     n.a.   n.a.   n.a.
 2004-Nov-16 03:45     19 22 14.42 +03 47 30.0 19 22 27.61 +03 48 01.8 257.3658  24.3984  12.64   n.a.  83.2     n.a.   n.a.   n.a.
 2004-Nov-16 04:00     19 22 17.85 +03 47 26.5 19 22 31.04 +03 47 58.2 259.7233  21.3562  12.64   n.a.  83.2     n.a.   n.a.   n.a.
 2004-Nov-16 04:15     19 22 21.29 +03 47 22.9 19 22 34.47 +03 47 54.7 261.9983  18.2916  12.64   n.a.  83.2     n.a.   n.a.   n.a.
 2004-Nov-16 04:30     19 22 24.72 +03 47 19.4 19 22 37.91 +03 47 51.2 264.2079  15.2101  12.64   n.a.  83.2     n.a.   n.a.   n.a.
```

By using this table in combination with Starry Night, you can get an immediate determination that your data entry has been successful. Starry night should have the same RA/Dec as shown in the table for the same point in time (within a few arcminutes, since Starry Night doesn't go to as many decimal places as JPL does). Simply pick a date/time off the ephemeris table and set Starry Night to the same date/time and find your comet/asteroid. The coordinates should be pretty close. My experience is that it's a pretty good system for finding new or faint objects.

The other great advantage is again that handy ephemeris table. If you have a GOTO type telescope and a computer but it's not a laptop, you can copy the ephemeris table into Excel (my preference for doing spreadsheets) and print out a hardcopy ephemeris table. Since a copy/paste of this will generate each line as a single-cell text item, it'll be necessary to separate the data out into columns. Alternatively, one could just use Word or WordPerfect and print the whole table (or even just print it straight from the JPL website). The only reason I prefer copying and editing in Excel is that when you're in the field, the only information you need is the time, RA and Dec. In fact, the JPL table gives RA/Dec with atmospheric-apparent adjustments (the a-apparent) columns. I've found those useful only for very low on the horizon so I usually delete them. In the end, what I have used in printed form is just the date column, RA, Dec, T-Mag (occasionally N-Mag) and, just for reference, the Cnst (constellation) columns. Be aware that this table is much wider than shown here. Of course, one could go through the trouble of choosing the outputs during the setup but I've usually found it easier to delete what I don't need afterwards than to try to figure out what each of the output descriptions meant.

So there you have it. Two fairly easy ways of ensuring that you can use your Starry Night (or other planetarium) software to find that new comet that has just been announced. I have used this with great success at finding very faint comets and to observe many asteroids.