

# RADIO SKY MAPS



**varian, EIMAC division**  
301 industrial way  
san carlos, california 94070

The two radio sky maps presented in this note were copied from the Proceedings of the IEEE, April 1973. The temperature contours plotted on these maps tell an observer where the hot (noisy) and cold (quiet) areas of the sky are located. This information is useful to a moonbounce operator because, if the moon is in front of a hot spot, the radio frequency radiation may mask or completely override any echoes. Also, those amateurs who want to check out antenna gain, or receiver noise figure, may want to find a hot spot to use as a signal source.

The radio sky maps use for their coordinates, Right Ascension and Declination. Most moonbouncers have an understanding of Declination, but Right Ascension is normally not used. The Nautical Almanac and most of the computer and calculator programs presented in the EIMAC EME notes use GHA, or Greenwich Hour Angle. The main difference between the two systems is the starting reference point. Astronomers use the Right Ascension and Declination system, whereas navigators tend to use Greenwich Hour Angle and Declination.

Greg Roberts, ZS1BI, a professional astronomer in Observatory, South Africa, was asked if he would explain the method for converting the Nautical Almanac GHA data into R. A. (Right Ascension). Greg's contribution follows:

I was most interested in the radio sky maps, especially the one for 136Mhz as this is covered by my satellite tracking equipment. I gave your request some thought and I think my solution is as easy as they come. I will do a sample calculation in some detail so that anyone should be able to follow it... I hope.

Problem: Determine the Right Ascension (R. A.) and Declination (Dec) of the moon, using only the Nautical Almanac.

Approach: Select the data and time for which the data is required. Let us suppose it is October 31, 1979 at 09hr GMT (or UT). From the Nautical Almanac for 1979, we find for this date that the Greenwich Hour Angle (GHA) of the moon is 187 degrees 51.8 minutes, whilst the Dec is 6 degrees 40.6 minutes south. For intermediate times, eg 9hr 30 min, interpolate in the tables given.

Method:

I. Convert GHA to hours and minutes decimal minutes as follows

(i) convert minutes of GHA to decimal degrees

$$\text{eg } \frac{51.8}{60} = 0.86333$$

(ii) convert GHA, which is now 187.86333 degrees, to hours decimal hours as done by

$$\frac{187.86333}{360} * 24 = 12.524222 \text{ hours}$$

(iii) convert decimal part to minutes decimal minutes

$$\text{eg } 0.524222 * 60 = 31.453 \text{ minutes}$$

Hence GHA as hours minutes decimal minutes is 12 hr 31.453 minutes.

2. Determine the day of year corresponding to October 31.

For 1979, January = 31, Feb = 28, March = 31, April = 30,  
May = 31, June = 30, July = 31, August = 31, Sept = 30  
and Oct = 31.

The total of all this is 304 days.

(Don't forget a leap year has 29 days in Feb !)

3. Compute the sidereal time at Greenwich for the Universal Time and day chosen, eg sidereal time at Greenwich for October 31, 1979 at 09 hours UT.

The formula to use is

$$\text{Sidereal Time (S.T.)} = \text{constant} + 1.0027379 * T + 0.06570982 * D$$

where the constant is selected for the particular year (the constant is actually the sidereal time for January 0.0 of the year involved), and is in hours decimal hours, T is the time required for, again in hours, and D is the year day. Substituting we get

$$\begin{aligned} \text{S.T.} &= 6.604441 + 1.0027379 * 9 + 0.06570982 * 304 \\ &= 6.604441 + 9.024641 + 19.975785 \\ &= 35.604867 \end{aligned}$$

Express this in the range 0 to 24 hours by subtracting 24 hours and we get

Sidereal Time required = 11.604867 hours.

Convert the decimal part to minutes decimal minutes as follows:

$$0.604867 * 60 = 36.292 \text{ minutes}$$

Thus S.T. is 11 hours 36.292 minutes

4. Determination of R.A. of Moon

$$\begin{aligned} \text{R.A.} &= \text{Sidereal Time} - \text{Greenwich Hour Angle} \\ &= 11 \text{ hrs } 36.292 \text{ min} - 12 \text{ hrs } 31.453 \text{ min} \end{aligned}$$

Since this would give a negative R.A., ADD 24 hours to the sidereal time, hence

$$\begin{aligned} \text{R.A.} &= 11 \text{ hr } 36.292 \text{ min} + 24 \text{ hr } 00 \text{ min} - 12 \text{ hr } 31.453 \text{ min} \\ &= 35 \text{ hr } 36.292 - 12 \text{ hr } 31.453 \text{ min} \\ &= 23 \text{ hr } 04.839 \text{ min} \end{aligned}$$

#### Conclusion:

We thus find for October 31, 1979 at 09 hrs GMT, that the position of the moon is

R.A. 23 hours 04.839 minutes  
Dec. 6 degrees 40.6 minutes south

The Astronomical Ephemeris for 1979 give the position of the moon as

R.A. 23 hours 04.800 minutes  
Dec. 6 degrees 40.7 minutes south

The answer is thus satisfactory.

Note that the determination of the R.A. of the moon is INDEPENDENT of your longitude and latitude and Part 3 is the only "complicated" part.

CONSTANT TO BE USED FOR VARIOUS YEARS:

|      |          |      |          |
|------|----------|------|----------|
| 1978 | 6.620418 | 1982 | 6.622408 |
| 1979 | 6.604441 | 1983 | 6.606493 |
| 1980 | 6.588527 | 1984 | 6.590579 |
| 1981 | 6.638322 | 1985 | 6.640374 |

One could work in hours decimal hours and forget about converting to minutes decimal minutes etc. We then have:

- 1.(ii) GHA = 12.524222 hours
3. S.T. required = 11.604867
4. R.A. = 11.604867 - 12.525222 = - 0.919355  
ADD to 24 hrs. and we get  
R.A. = 23.080645 hours  
or R.A. = (11.604867 + 24.0000) - 12.524222  
= 35.604867 - 12.524222  
= 23.080645 hours

Converting to minutes decimal minutes we end  
with R.A. = 23 hours 04.839 minutes

You might want to point the EME array at a selected R.A. and Declination, and for this you need the GHA. Using the same equations in the proper manner, it is possible to calculate the equivalent GHA and Declination.

Well, that's it. There are other refinements that could be introduced, but I do not consider them necessary in this case since the accuracy with which one can plot the moons position on the charts is limited by the scale of the charts, and with the moon about half a degree in diameter, a small error does not matter. Also I note that the year in which the chart was plotted is not given. Due to precession there will be a slight displacement in R.A. and Dec. of the contour lines, but here again the shift is small enough to ignore for our purposes.

Greg Roberts, ZS1BI  
P. O. Box 9  
Observatory 7935  
South Africa

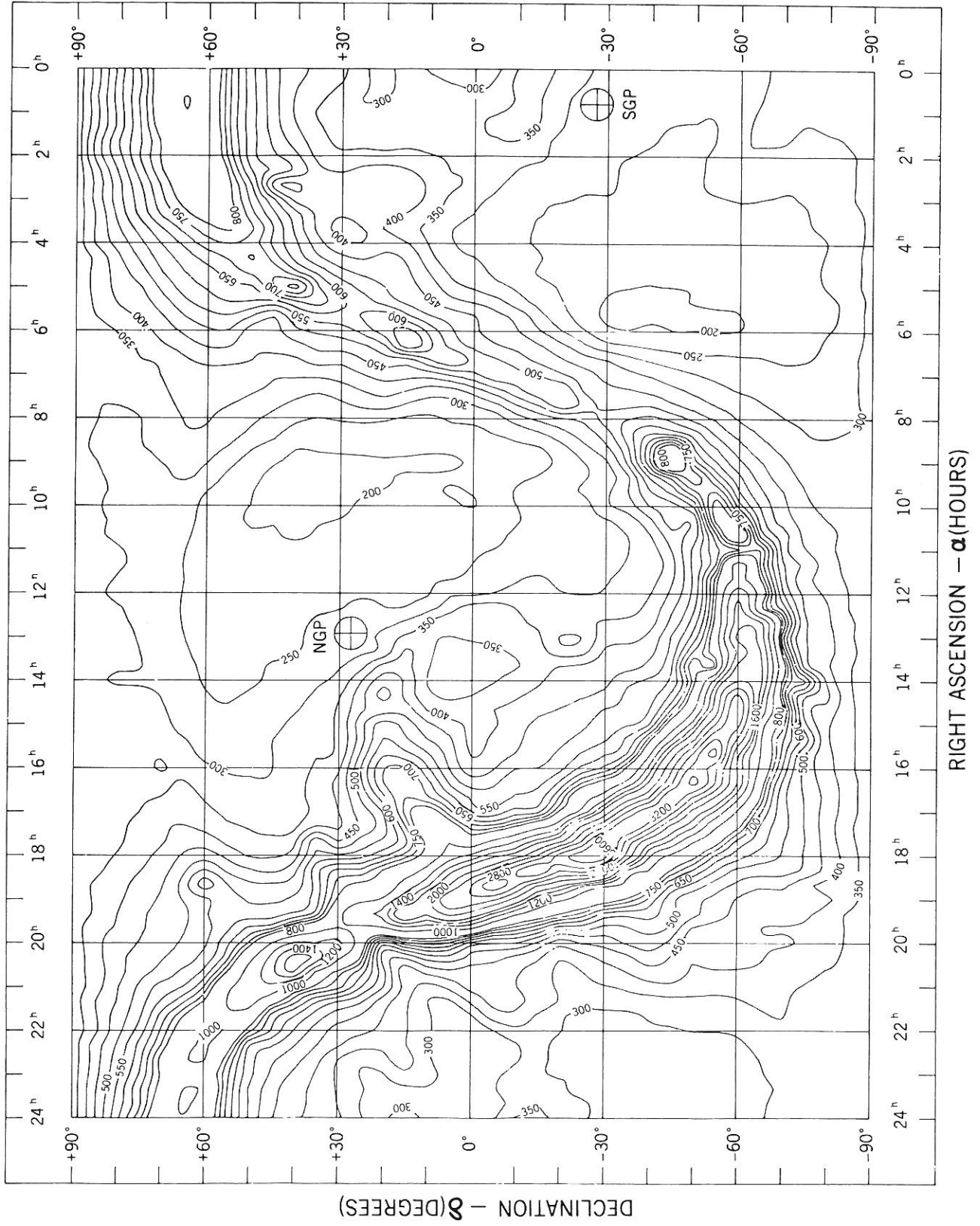
The asterisk appearing in Section 3 is the symbol used by computer programmers to denote multiplication.

Those amateurs using a computer program such as the one written by Lance Collister, WA1JXN, the Right Ascension is calculated within the program and converted to GHA for print out. The program can be changed to print out the R.A. along with the GHA. This feature would be useful with the radio sky map.

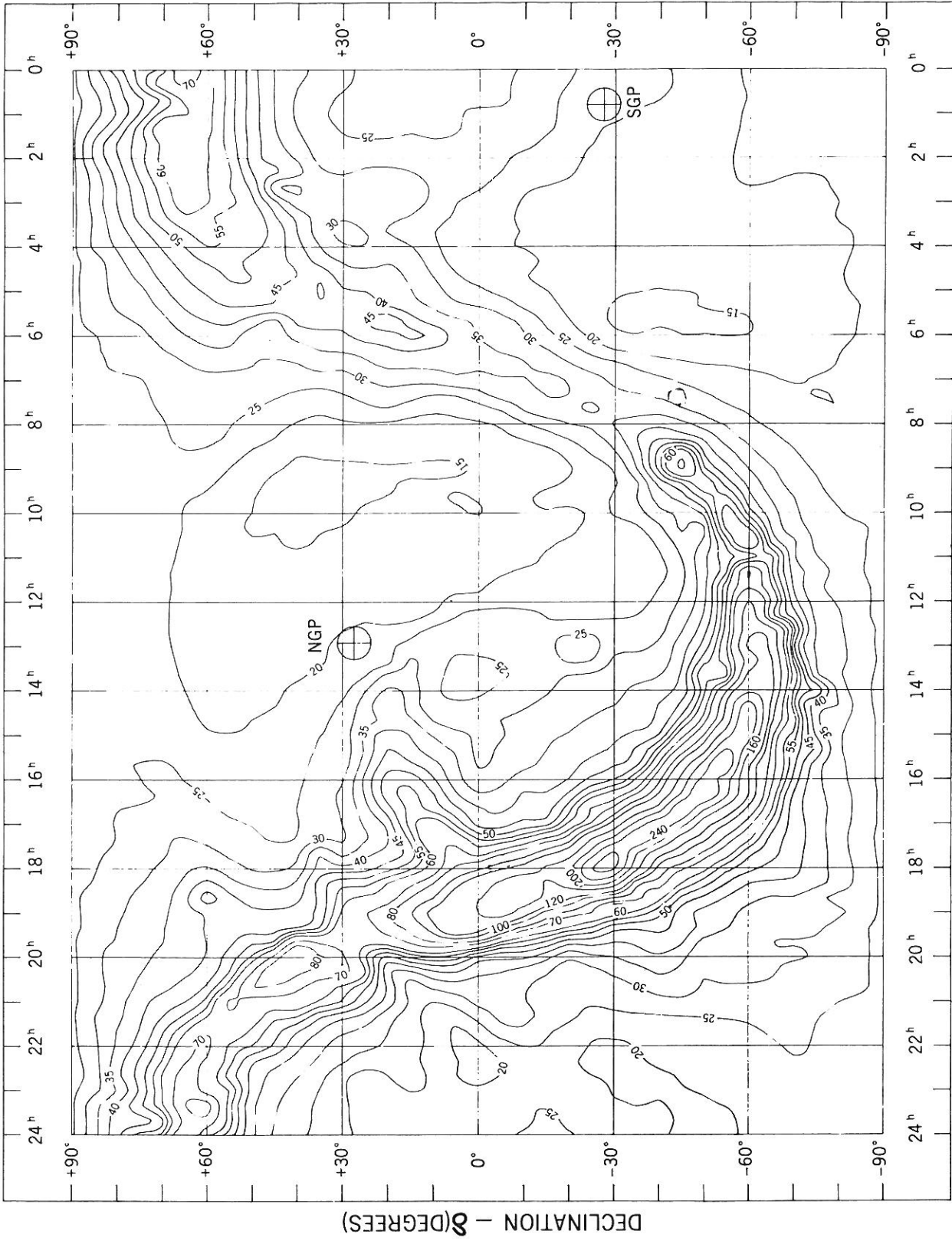
For determining the day of the year as in Section 2 of Greg's write-up, the Nautical Almanac has a table near the front of the book which gives this information.

Every month in the "Sun, Moon, and Planets This Month" section of the Sky and Telescope Magazine there is a sky map with the moon position plotted for several days of the month. The X-axis of this map is Right Ascension in hours. Therefore, with this map and the radio sky map, it is possible to determine if the moon is in front of a quiet or noisy part of the sky. Incidentally, the Sky and Telescope Magazine also is a good source for predicted meteor shower activity and the expected peak days.

136 MHz BRIGHTNESS TEMPERATURE (KELVIN)



400 MHz BRIGHTNESS TEMPERATURE (KELVIN)



RIGHT ASCENSION -  $\alpha$ (HOURS)

