DERIVING VISUAL MAGNITUDES FROM THE "TRUE VISUAL MAGNITUDE" CHARTS

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Abstract

A method for constructing finding charts and magnitude sequences is described.

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Whenever the discovery of a nova or other new variable is reported, there usually follows a frantic search for a suitable finding chart, preferably one having the standard variable star scale of 20"/mm. As such a chart should be ready for use as soon as it gets dark, it had best be copied from some existing chart. Ideally suited for this purpose are the Papadopoulos (1979) "True Visual Magnitude" (TVM) charts, as they show all stars down to magnitude 12 - 13, regardless of color, with the relative brightness as seen by a visual observer. The scale of 120"/mm is, however, too small for most purposes, and enlargement is necessary. Doing this photographically would be precise, but impractically laborious, and it was for this reason that the simple projector shown in Figure 1 was built.

The chart on the base plate is illuminated by four low-voltage lamps (for best light-to-heat ratio) and the image is projected through a standard 35-mm camera lens onto a piece of tracing paper which has been taped to the glass plate at the top. Dimensions have been adjusted to produce a 6x enlargement, which corresponds to a scale of 20"/mm. In a partly darkened room only a few minutes are needed to trace, by pencil onto the tracing paper, all the significant stars.

Having completed this step, the question arose: might there perhaps be a simple relationship between the magnitudes of the stars and the size of the images on the chart? A rough check, carried out by measuring the enlarged images with a millimetre scale, and comparing them with magnitudes from the best available variable star charts, suggested a linear relationship between magnitude and image diameter. More accurate measures directly from the original charts, made with the aid of a small 50x microscope with a built-in scale which could be read to 0.01 mm, confirmed this relationship over the range of magnitude between approximate magnitudes 6 and 13. There is some evidence of curvature below magnitude 6.

Figure 2 (TVM chart 53, magnitudes from Royal Astronomical Society of New Zealand chart 353 for W Nor) shows one of the better examples of a straight line. The relationship thus found may then be used for deriving magnitudes for other stars on the same TVM chart. In favorable cases these have been found reliable to within a few tenths of a magnitude, but not all results were this accurate.

It is necessary to derive for each chart its own curve, and this depends on what magnitudes happen to be available. Magnitudes are most readily obtained from variable star charts, but these tend to be almost as variable as the stars they portray, and many of the older ones are of somewhat doubtful accuracy. A few examples of discordant results are shown in Figure 3. In cases like this measuring the TVM images may not result in the perfect variable star chart, but it may at least help to correct some of the more gross errors of existing charts.

Lastly, there are the TVM charts covering regions containing no variable star chart areas whatever. In such cases an average calibration curve, as obtained from other charts, may be adopted as a first approximation. Alternatively, magnitudes may be obtained from some other source, e.g. from the **Smithsonian Astrophysical Observatory Star Catalog** (Haramandanis 1966). It should be remembered, however, that many such magnitudes were originally published mainly as a guide, and were not meant to represent accurate standard values. Some were, indeed, rounded off to the nearest half magnitude. Figure 4 shows an example of what might be expected. Magnitudes of stars near W Hya have been plotted, both as shown on the AAVSO variable star chart, and as listed in the **SAO Catalog.** It will be seen that there is good agreement around magnitude 8, but that the slope of the SAO curve is abnormally low, and that there is an increasing divergence at fainter levels.

REFERENCES

Haramandanis, K. L. 1966, **Smithsonian Astrophysical Observatory Star Catalog**, Smithsonian Institution, Washington, D.C.

Papadopoulos, C. 1979, **True Visual Magnitude Photographic Star Atlas**, Pergamon Press, New York.

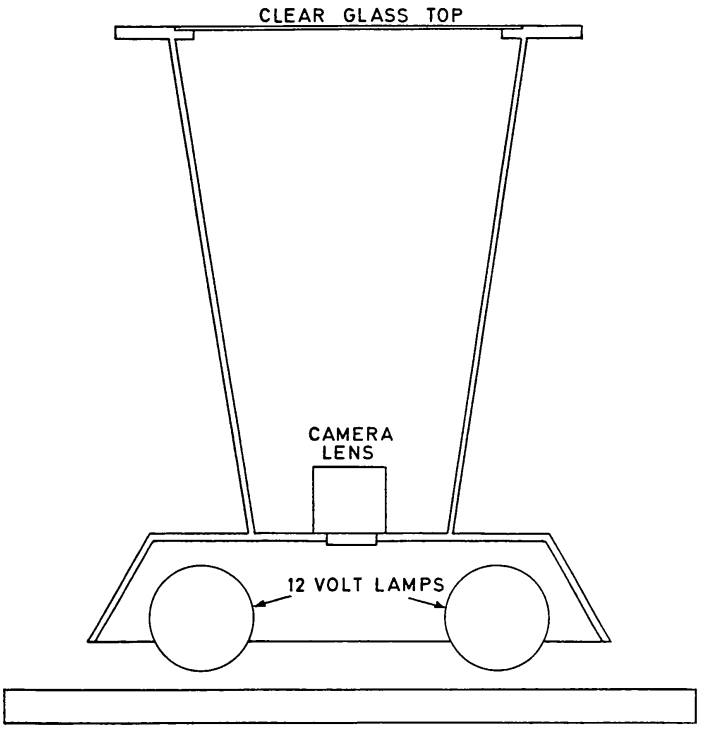

Figure 1. Enlarger built by the author to prepare star charts on short notice without first having to photograph the field.

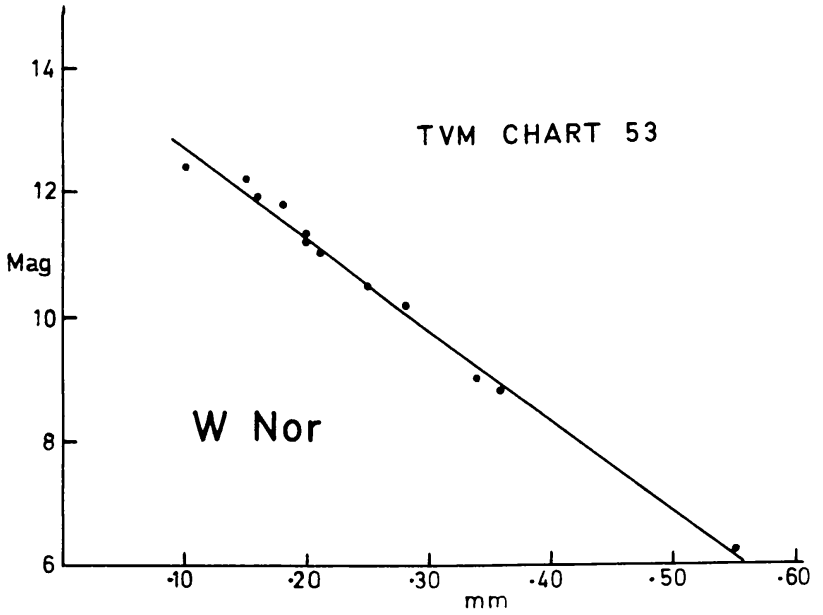

Figure 2. TVM Chart 53. Magnitudes are taken from Royal Astronomical Society of New Zealand chart 353 for W Nor. This chart shows well the linear relationship between magnitude and image diameter.

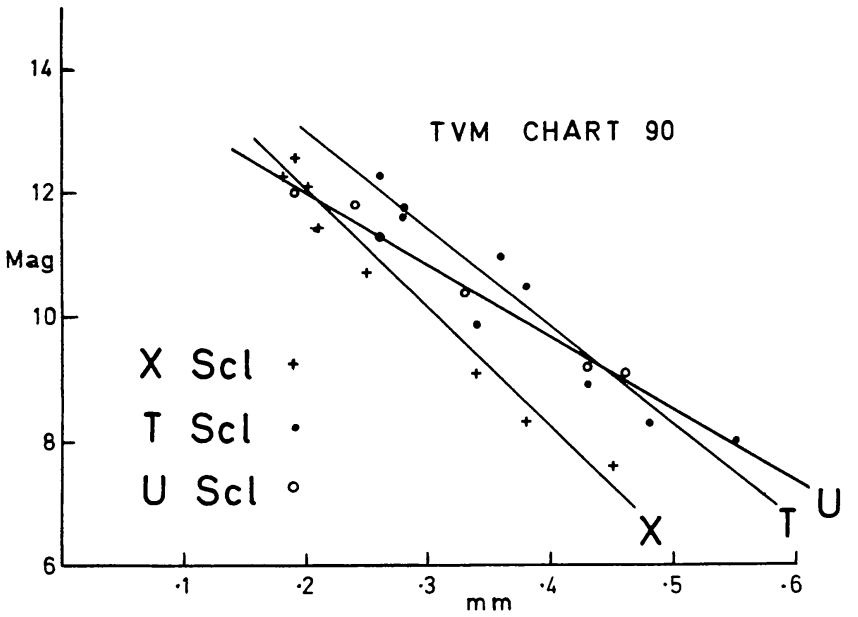

Figure 3. TVM Chart 90 shows discordant results of the magnitude-image diameter relationship analysis.

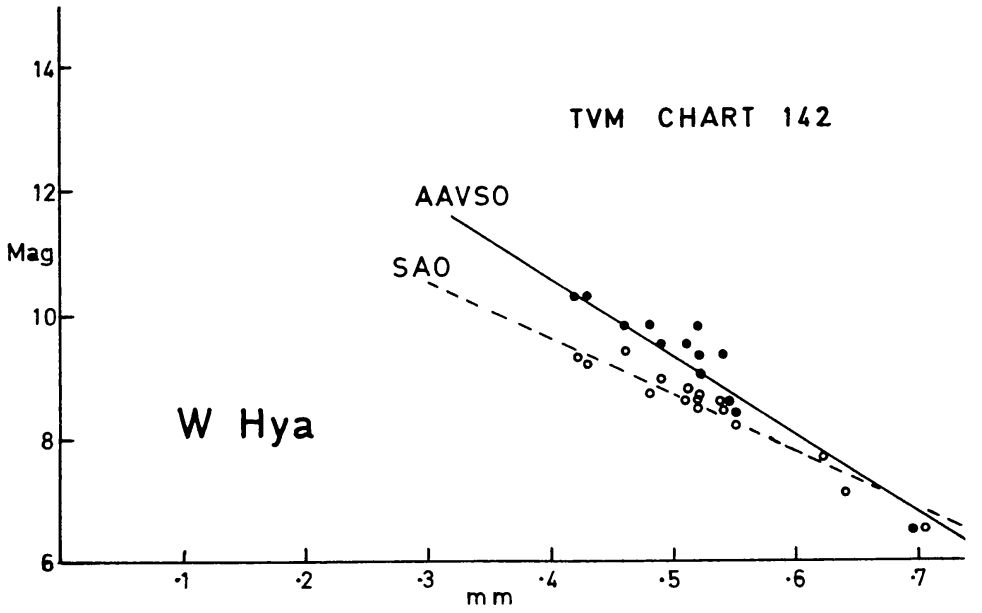

Figure 4. TVM Chart 142 shows the results of using SAO magnitudes to create a standard average curve. The agreement between AAVSO and SAO magnitudes is seen to be good around magnitude 8, but increasingly poor at fainter magnitudes.