On Descriptive Geometry

I recently came across Andrew C. Whyte's book, *How to Draw Aircraft Like a Pro,* wherein he describes how aviation artists can improve their drawing accuracy by using a variety of techniques, including a geometry system widely know as *Descriptive Geometry* (DG.)* It's the method he used to draw the *F4U Corsair* and the *Mitsubishi Kate* for a World War II painting.

I suggest that users and potential users of the DG system would be wise to take note of the quality of images projected by that method when the elevation and/or azimuth angles are increased from relatively shallow viewing aspects to higher ones. An examination of the DG system shows that it does not match the claims for accuracy and precision. This can be verified by comparing images produced by it to equivalent images produced by cameras, computer or CAD programs, or on a more equal footing, to other drawing-board geometry systems. In this article, the drawing-board geometry system used for comparison is the *Geometric Projection Method* (GPM) that was featured in the ASAA newsletter*, AeroBrush*, *Spring 1992* issue, and reprinted by request as *Brush Tip #2* in the *Winter 1995-96* issue, and in the GAvA Quarterly News, *Spring 1997* issue.

The general configuration for making a DG perspective projection has the plan view of the object to one side of the layout, and either the front or the side view on the other, as in Fig. 1. The eye position (EP) for the Azimuth view of the object is located by rectangular dimensions A and B. Similarly, A and C locate the EP for the Elevation view. The Azimuth and Elevation angles, shown here for reference, are not usually specified in a DG layout, nor is a true-length line-of-sight viewing distance. (The mechanics of projecting a perspective via the system are not relevant to the issue at hand.)

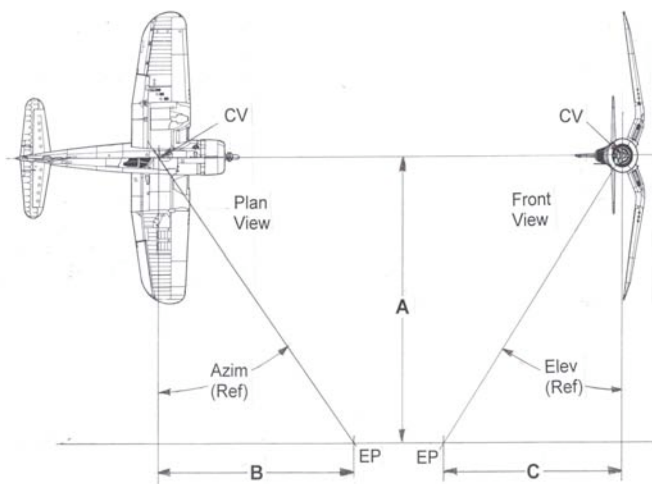

Fig. 1— Rectangular coordinate dimensions A, B, C for locating the eye positions for a DG projection.

In the book, Andy recommends the use of boxes and cubes as an aid to good drawing, presumably on the premise that if the box is right then its contents too, must be right. To simplify the understanding of the premise, a 3-inch cube is used in Fig. 2 to illustrate the change in image shapes when the elevation viewing aspect of the DG cube is raised from 20º to 40º in a series of three steps. The illustrations apply equally to more complex shapes; e.g., aircraft. The cube is centered on the picture plane's center of vision (cross hairs) at a calculated viewing distance of 12.22 inches. The changes are effected by increasing the value of the C coordinate and adjusting the A and B coordinates <u>in order to maintain the same Azimuth viewing aspect and viewing distance in all the diagrams</u>. Mathematical equations have been applied to both the DG and GPM geometries to maximize the accuracy of the plots. To the right of each DG image is a corresponding GPM image with viewing parameters interpolated from the DG coordinates. (DG uses rectangular coordinates for the object's orientation; GPM uses polar coordinates. Either coordinate system is convertible into the other.)

* *Descriptive geometry* is a generic term that applies to any system of geometry that uses plane projections and perspective drawings.

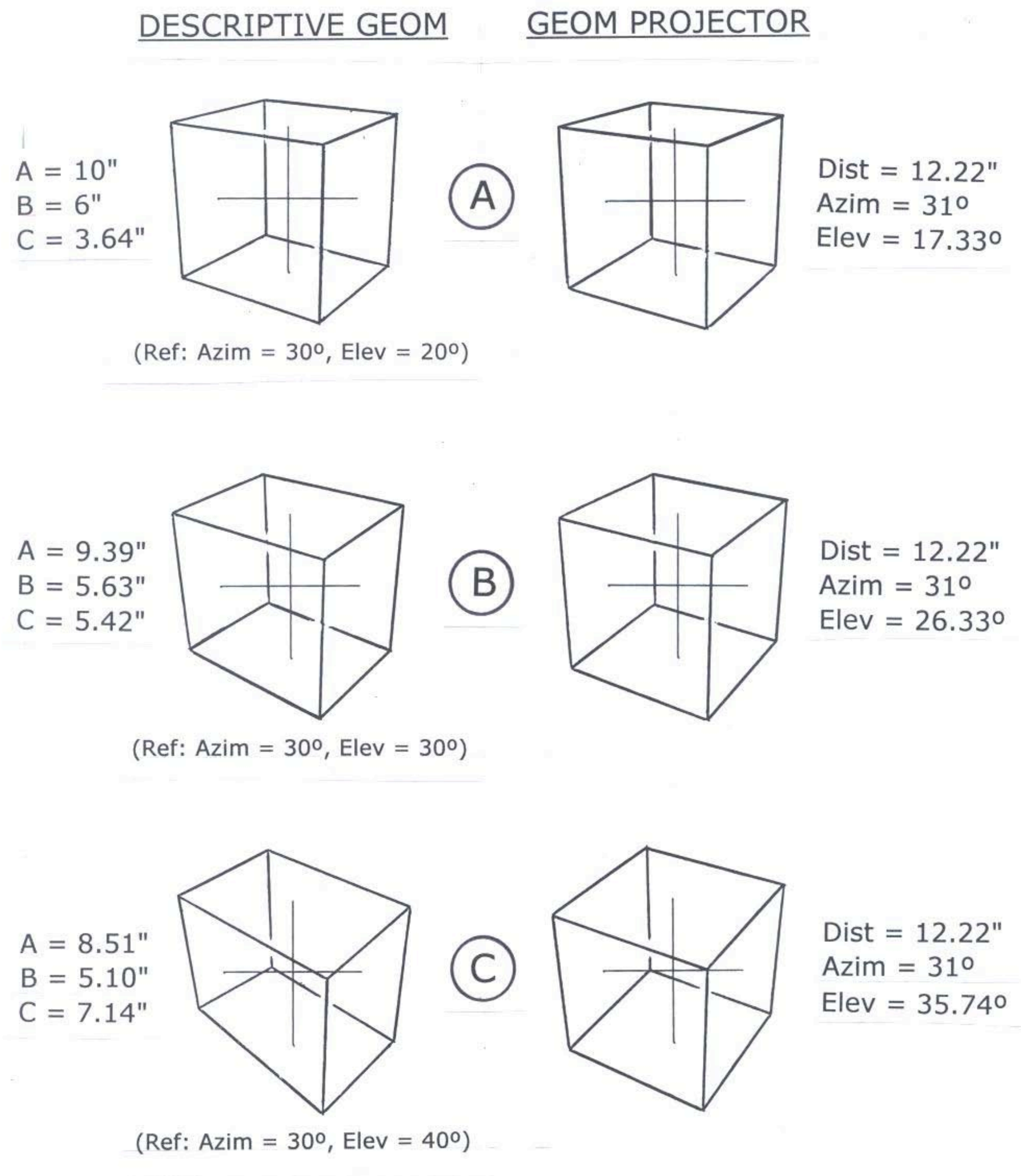

Fig. 2 –

(A) – Viewed at a relatively shallow 20^o elevation angle, the DG cube shape appears slightly compressed in comparison to its GPM counterpart.

(B) – When the elevation angle is increased to 30^o the DG image becomes more oblong than cubical.

(C) – At a 40^o elevation angle the DG figure is no longer cubical.

For visual confirmation that the viewing aspects of corresponding images are compatible, *note the similarity in the framework of lines bounding the cross hairs at the centers of the images.*

The essence and ultimate test of a "perspective" lies in the convergence of its parallel lines to vanishing points. In that regard, Andy has this to say, *prove the drawing by establishing vanishing points.* However, as shown in Fig. 3, DG cannot meet the challenge.

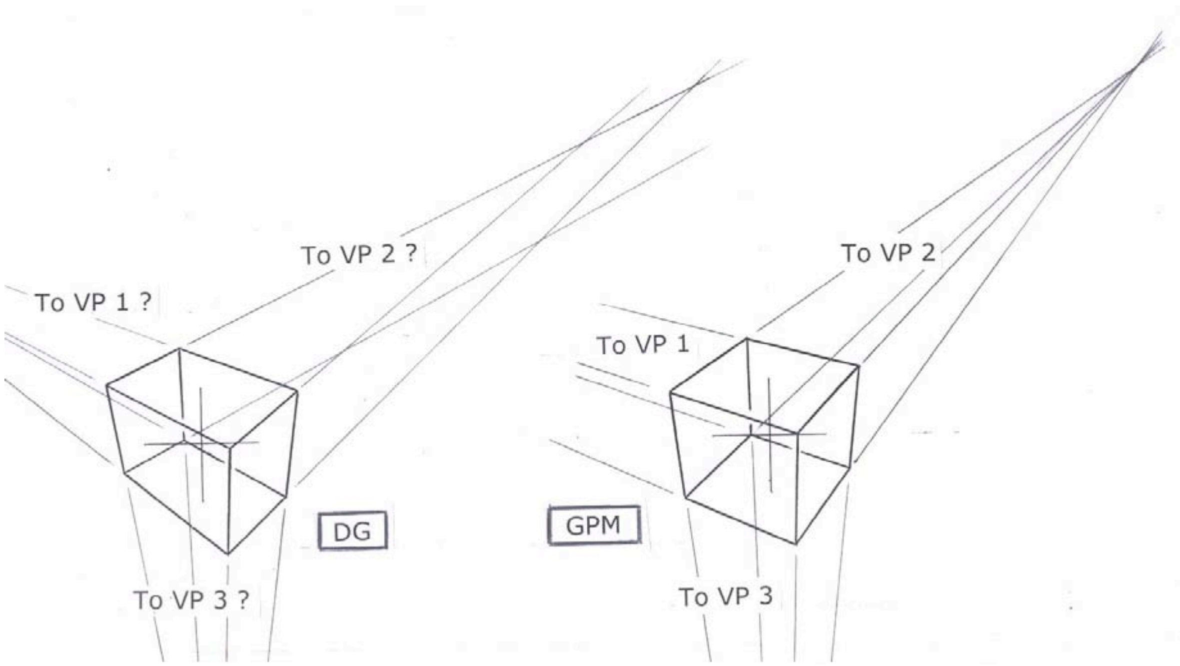

Fig. 3 — Lines extended from the DG *image (left) do not converge to a single vanishing point as do those of the* GPM *image (right.)*

I call the DG system into question because I believe the foregoing proves that it is subject to some fundamental geometrical inaccuracies, and because I believe no other art genre embraces accuracy in its depiction of machines and events to the extent that aviation art does. It seems to me that any artist who has ventured into what many of our colleagues regard as the *awesome realms of perspective* would at least be open-minded enough to look at an alternative system, even if it challenges the belief that he or she is already using the best system there is.

For a detailed description of the *Geometric Projection Method*, and to learn about the PC software version, *Artists' Perspective Modeler (APM),* visit www.aviart.info.

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