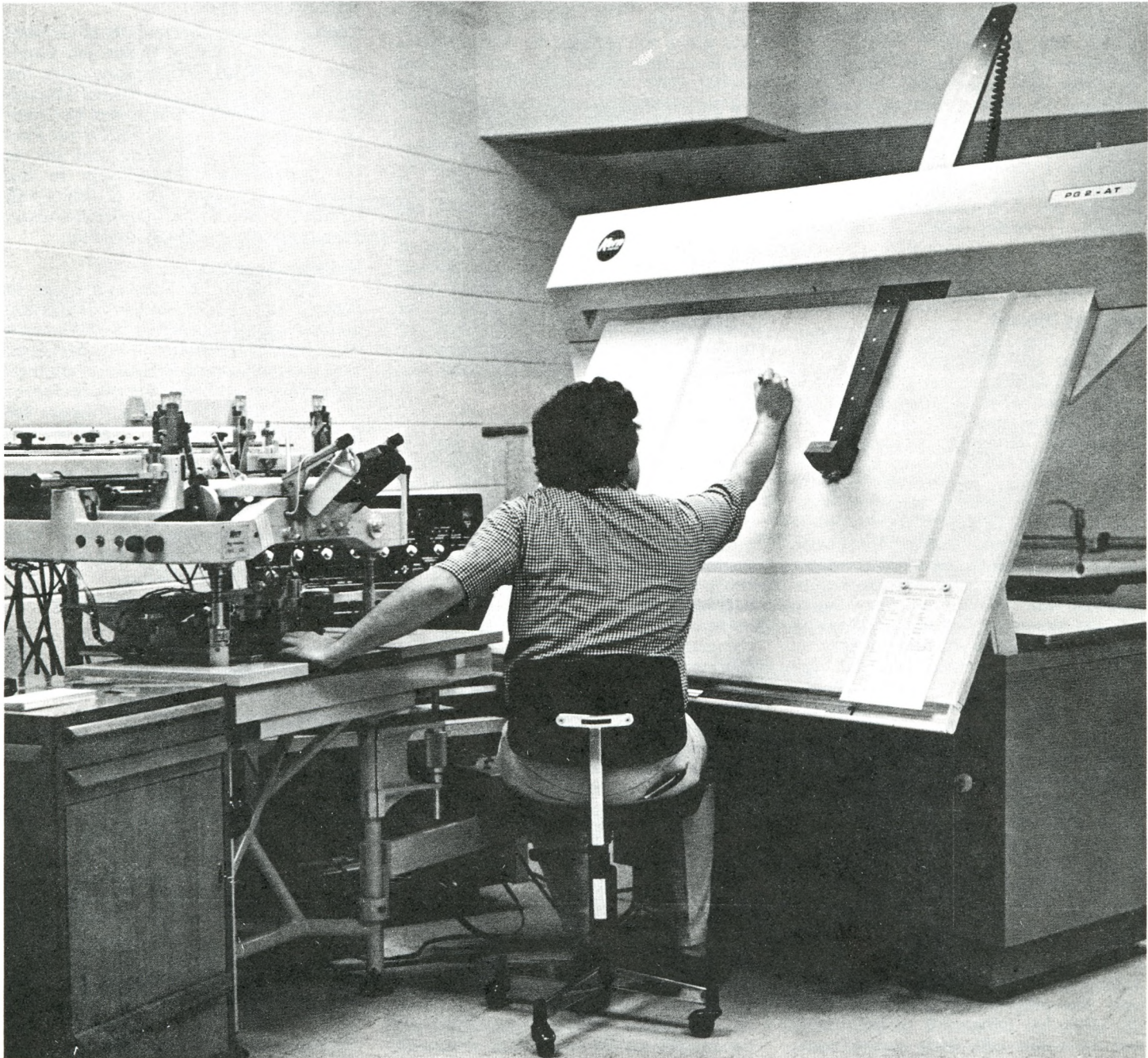# Kern PG 2-AT
Semi-Automatic
Stereoplotter System By T. P. JONES

The above system is a combination of a mechanical analogue stereoplotter and an automatic drafting table for the continuous on-line plotting of all natural features, and the semi-automatic digital plotting of all man-made features.

The Company points out that the user can start out with the basic PG2 stereoplotter, and by adding one building block after another, arrive at an integrated plotter system which will solve nearly all the mensuration and plotting tasks found in a modern mapping organisation.

Using a typical stereoplotting instrument, the plotter operator spends considerable time on fair-drawing in order to present the data extracted from the photographs in the form of a neat looking manuscript. Drawing of straight lines, symbols, dashed and dotted lines, curves, etc. are time consuming if done by hand.

The PG2-AT in its basic configuration consists of the PG2 stereoplotter fitted with X, Y and Z encoders, and the AT automatic plotting table.

The Kern DC2-B Digitizer-Graphics Computer serves as the link between the PG2 stereoplotter and the table. The micro-processor provides the operator with different working modes.

In the "track mode", continuous on-line plotting of contours, creeks, trees, etc. is carried out in much the same manner as conventional plotters.

In the "line mode", however, planimetric detail is no longer traced or ticked, but is obtained from accurate single pointings. The automatic table draws a straight line between two points. For example, the operator positions the floating mark at house corners only, the table draws the lines representing the sides of the house.

Since all man-made features are plotted as straight or curved lines semi-automatically, no table assistant is needed. Plotting times of large scale, dense-detail models have been reduced between 30% and 70%, as compared to conventional stereo plotting methods.

In the "off-line mode", the data may be recorded for the later automatic drafting of the digital data.

The inter-relationship of the various units is indicated in Figure 1. Following are brief descriptions of those units shown therein in heavy outline.

The Stereoplotter

The PG2 stereo plotting instrument is used for the production and revision of topographic maps at all scales, large, medium and small, from superwide-, wide-, and normal- angle photography.

It is a mechanical projection instrument, known for its versatility, convenience of operation, accuracy, and overall stability. It is said to be a second order plotter. This is an unsatisfactory statement, as plotting accuracy is not solely a function of the instrument but also depends upon other variables such as quality of photography, operator ability, etc. It is known that the PG2 has a good planimetric and height accuracy, which equals that of conventional first order plotters.

The PG2 can accommodate original size transparencies and prints up to 230mm square from all types of cameras with focal lengths between 85 and 172mm. Illumination is by white light, so colour photography can also be used.

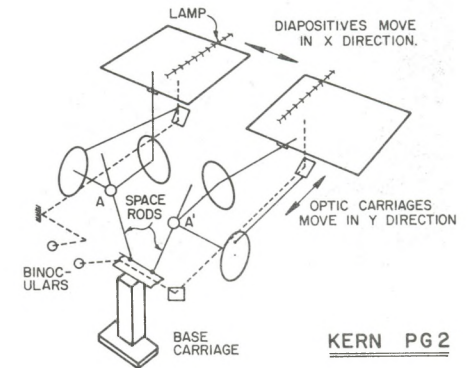The basic principles of the machine are illustrated in the simplified diagram of Figure 2.

FIGURE 2.

Diapositives are placed in carriages and illuminated from above. The two precisely manufactured metal space rods are free to rotate about gimbal joints A and A' and they can also slide up and down through these joints. A and A' are fixed in position.

The viewing system consists of two individual optic trains, illustrated by dotted lines in Figure 2. An operator looking through the binocular eyepieces sees the diapositives directly and perceives the stereomodel.

Scanning in x and y is done by manually pushing the base carriage. The carriage slides with three ruby gliders on an accurately ground plastic surface, which provides a smooth and precise free hand scanning of the model.

During scanning, the photocarriages move in x direction only, and the observation optic carriages move in y direction only. Consequently, the observation system is a very simple one.
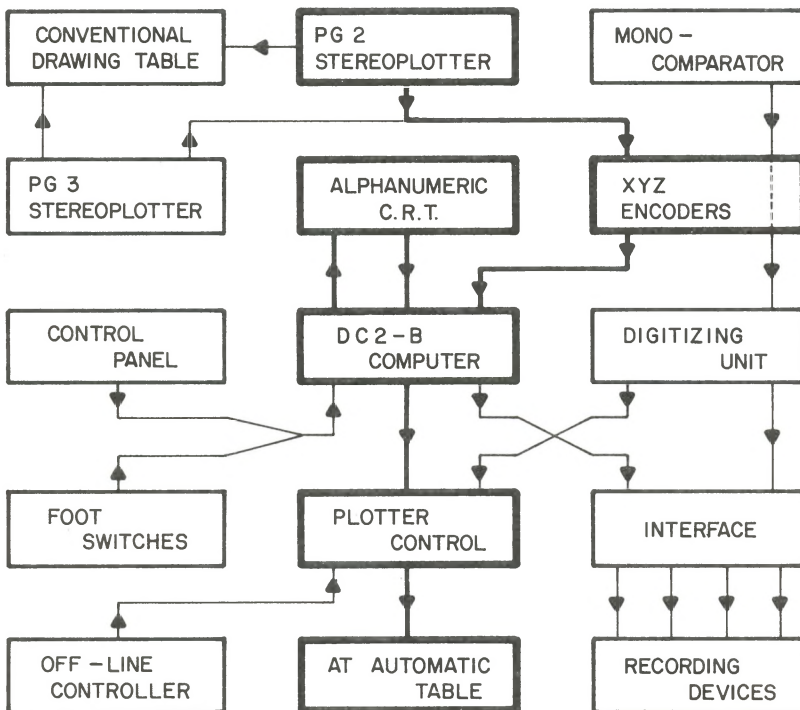
The horizontal scanning motions are

FIGURE 1.

transferred to the regular PG2 drawing table by a stable polar pantograph when enlargement or reduction is required, and by an arm which is rigidly attached to the base carriage, for plotting at model scale only.

Electronic signals guide the pen or pencil when the PG2 is connected to the **automatic drafting table.**

Figure 3
- Base carriage
1 Base setting knob
2 BΦ setting knob (B_z)
3 Height counter
4 Setting knob for reading meters and feet for different model scales
5 Z disk
6 Switch for pencil lifter
7 Elevation clamping screw
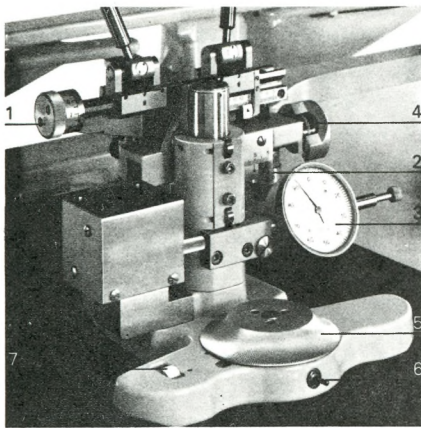
The upper part of the instrument, the main frame, has a three point support, whose height above the model table can be varied in eight steps of 10mm each, between the values of 102 and 182mm. With this variable setting of the main frame, the mean projection distance Z is introduced. In this way, it is possible to utilize the 60mm Z range of the base carriage for the actual elevation measurements in the model.

Rotary encoders in the model space of the specially fitted PG2 give a resolution of 0.005mm for all three axes. The x and y model coordinates are determined directly by a small coordinatograph which is driven by the base carriage. The motion of the base carriage is transferred to the incremental encoders by means of precise rack and pinion.

The Z encoder is driven directly by the Z disc.

The Digitizer-Graphics Computer
The DC2-B is a digitizing processor based on the DEC LSI 11 micro-processor with general purpose programmes stored in ROMS.

The processor accepts the incremental inputs from the X-Y-Z encoders of the PG2 stereoplotter, and processes that information under consideration of other inputs from the alpha-numeric CRT, the operator control panel and foot switches.

It outputs the information in three ways:—

a. to the operator as a display on the CRT so that he can monitor his own work and the status of the system,
b. to a data recording device,
c. to the plotter control processor and the plotting table for real time on-line plotting.

The keyboard and tube serve as data input and display terminal. The programme menu, the X-Y-Z model or ground coordinates, the event counter and the absolute orientation elements are displayed on the screen.

Basic parameters for manuscript preparation, etc. can be reviewed and changed if necessary. The allocation of line types and symbols to the function switches on the operator control panel is also done through the terminal.

Manuscripts can be gridded with solid lines or ticks, with or without border and annotation. Control points can be plotted.

Most line types are pre-programmed. The system allows ten automatic pen-up/pen-down patterns; certain patterns allow the embedding of symbols or characters which can be operator specified through the CRT keyboard. A set of fifteen symbols exist, which can be plotted at any scale and rotation.

For curvilinear interpolation, actual digitized points are joined by a smooth curve when plotted on the automatic table.

Upper and lower case letters and numbers can be attached to digitized features or symbols and plotted at selectable size and angle of rotation.

The AT Automatic Table
The plotter control accepts input either on-line or off-line from a suitable controller. Its function is to convert the digitized data in list and parameter form to strings of plotter commands to allow the generation of the characters, symbols, vectors, splined curves, arcs, circles, and any combination of these.

The plotting table in its standard form has a neat drafting area of 860 x 1360mm, and can be inclined over ninety degrees from the horizontal to the vertical position. The near vertical position has proven to be the most favourable for on-line plotting.

It is stepper motor driven from the impulses received from the plotter control. The drawing arm is moved by rack
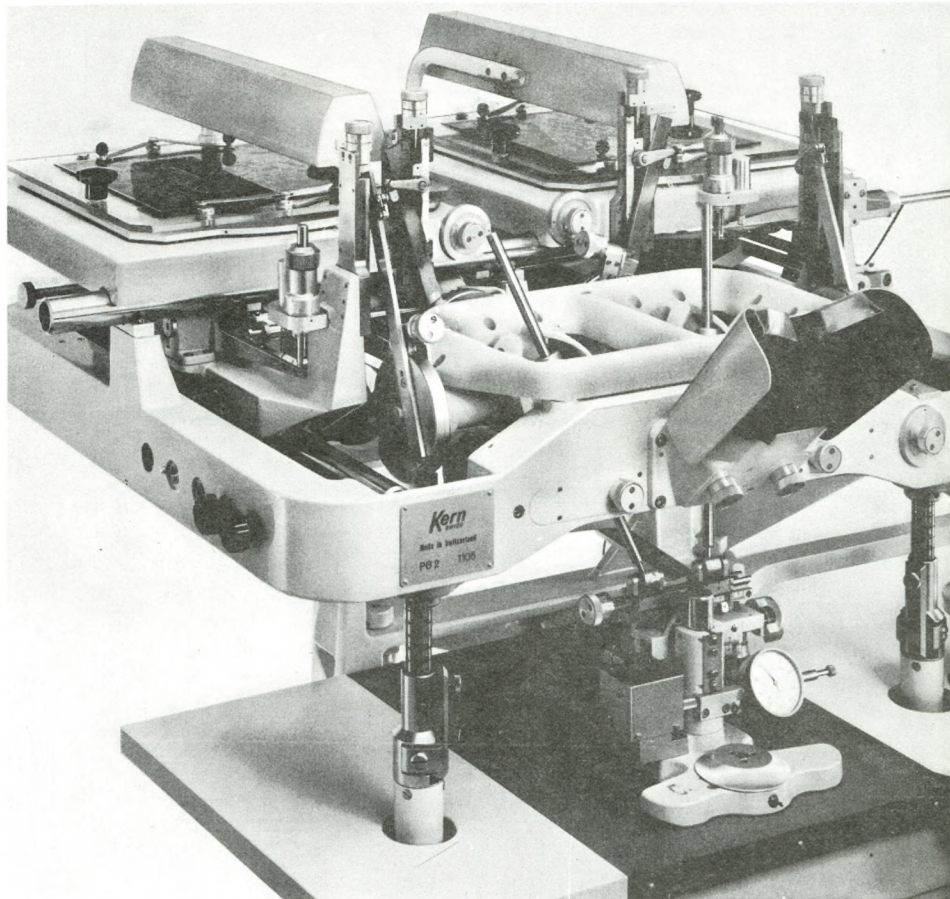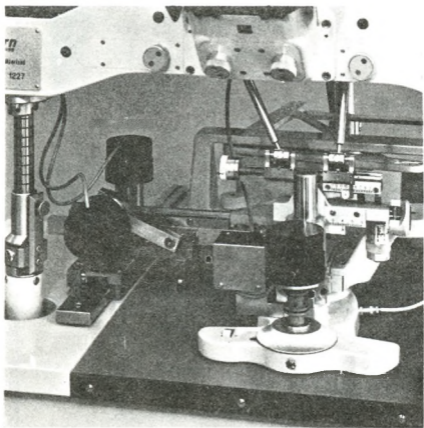

FIG.4   MAIN FRAME

FIG. 5   PG2 WITH ENCODERS

and pinion - the smallest step is 0.063-mm.

As the impulses from the encoders may be multiplied by the processor, any enlargement from the model to the plot is purely electronic, so that there is no degradation of accuracy when this is carried out.

The manuscript is drawn in ink with a pressurized ball point pen. A neat, directly reproducible manuscript is obtained which usually requires very little editing.