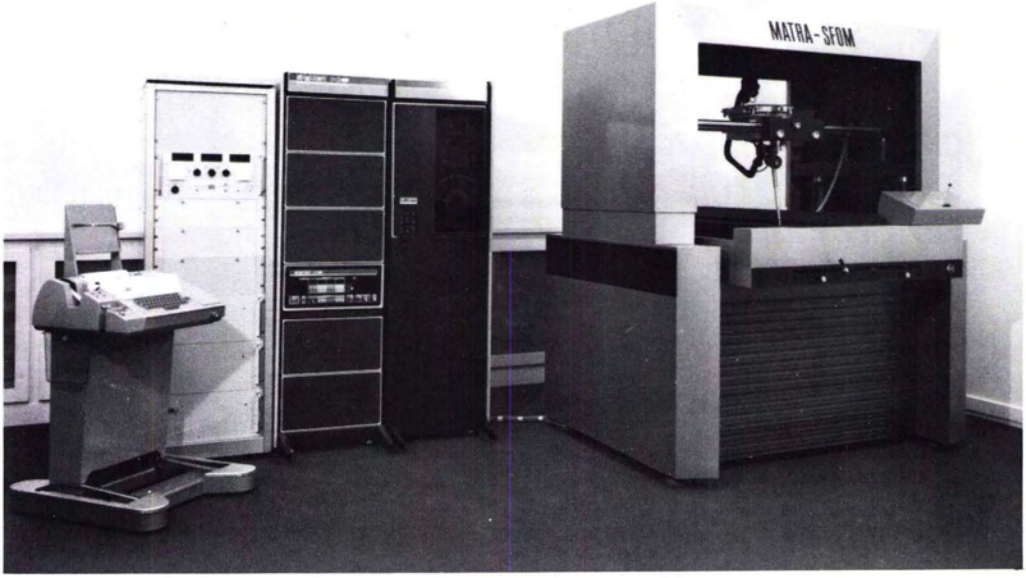

FRONTISPIECE. MATRA Type 910 Automatic Third Camera.

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MATRA Type 910 Automatic Third Camera

A computer-controlled off-line orthophoto printer capable of operating from profiles generated by various stereoplotters or from digitized contour plots.

(Abstract on next page)

DESCRIPTION OF THE EQUIPMENT

The type 910 Automatic Third Camera (Frontispiece) is composed essentially of an orthophotographic restitution instrument with one plateholder, a computer, a teleprinter equipped with a punched tape reader, a magnetic tape transport, and an electronic cabinet for supply and interface feedthrough.

The restitution instrument is derived from the MATRA/SFOM type 920 photoplotter and the type 693 orthophotographic unit (Figure 1). Orientation elements of the photograph to be reproduced may be introduced directly. Photography may be of all types in the standard cartographic range, from normal angle to super-wide-angle.

The orthophotographic table consists of a granite table with Z motion, to which is fixed the photographic emulsion, and of a coordinatographic unit ensuring the strictly precise travel, along two perpendicular axes, of a parallelepipenonal slit, the length of which

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ABSTRACT: *The MATRA Type 910 Automatic Third Camera is an instrument for automatic orthophotographic restitution. The restitution is achieved through the use of digitized terrain profiles, which form the basic control element. The configuration of the various units comprising the complete equipment are successively described, together with the role of each unit, its operation and, finally, the manner in which this instrument integrates in modern digital photogrammetry.*

may be adjusted by micrometric controls. Projection of the exposure onto the film, through the restitution optical systems, is ensured by a projector linked to the exposure plate-holder hinged around the nodal point of the lenses, and controlled by the travel of the slit-holder trolley so that the projector part of the image is always centered on the slit. X and Y travel of the slit-holder and Z travel of the table are governed by stepping motors controlled, in turn, either by pulses from the recorded profile or manually by a control box during setting and adjusting phases.

The essential characteristic of the restitution instrument is its rapid scanning speed. A Third Camera takes only about one third of the time to scan automatically that which would be required to scan manually a photogrammetric model. A single Third Camera can therefore accommodate three profile digitizing instruments.

A few theoretical and practical reasons for choosing a computer integrated in an Automatic Third Camera are that a single picture does not permit orientation between two consecutive points on a profile, the relief of the terrain is unknown, and that a magnetic tape can be safely read only block-to-block. It is necessary, therefore, to accumulate a great number of binary characters, to find the setting parameters of the exposure, to interpolate between two points on the profile, and finally, to command the motors in such a manner as to ensure that the shutter covers all the points of this profile.

These considerations point out quite clearly the interest that lies in introducing a computer into the system. Thanks to its storing and real-time calculation capabilities, it offers a neat solution to the problem raised. The functions of this data processing equipment, and consequently the main feature of the software developed for the operation of the Third Camera are, therefore:

- to calculate the orientation elements of the exposure to be reproduced;
- to determine the optimum scanning speed as a function of maximum ground slopes, taking into account the mechanical inertia in Z of the orthophotographic table and its motor's maximum speed;
- to interpolate between two consecutive points on the profiles so as to control the scanning motors, thus ensuring that the slit passes over the points on this profile;
- to check the authenticity of the profile points, correct and, if necessary, replace by fictitious points errors which may be found on the tape and signalled during recording; and
- to generate intermediate profiles for double or triple precision work.

The main purpose of the electronic cabinet is to ensure supply and control of the scanning motors on the basis of parameters fed from the computer. In addition, it possesses:

★ a system for visualizing X, Y, and Z slit travel;
★ a speed preselector switch in either X or Y according to the scanning direction chosen;
★ an indicator of the luminous flux received by the slit, permitting adjusting light intensity as a function of the speed of the film used and the authorized scanning speed; and
★ an operating mode changeover switch, either manual, for setting from the control box, or automatic.

OPERATION OF THE AUTOMATIC THIRD CAMERA

As an introduction to the operation of the Third Camera and the methodology of the acquisition of the profile necessary for this operation will now be examined. Although, theoretically, the magnetic tape containing the succession of recorded profile points suffices for the command of the "Third Camera", it is evident that various data forming the header are of use in aiding the operator during restitution. For example, the identification of control points required for exposure orientation, for scale setting, etc. Also, several codes are useful, such as the beginning of profile recording and error over 1 or n points.

At the end of this summary, the various

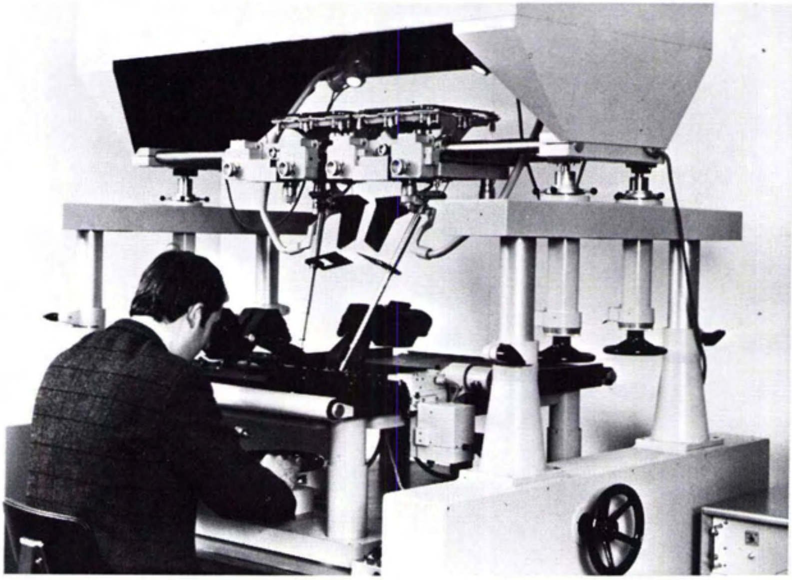


FIG 1. 920 Photoplotter and 693 Orthophotographic Unit.

possibilities for obtaining the profile will be reviewed. However, to take a concrete example illustrating the remarks that have just been made, we shall consider a profile digitized numerically in a photogrammetric model, and examine the ideal acquisition mode for a direct use of this profile with the Third Camera unit. After the stereoscopic model of the terrain has been established, the operator selects the scanning direction, i.e., *X* or *Y*, and the interval between points on a profile and between consecutive profiles as a function of the terrain relief. Then, using the coder thumb-screws, he enters into the tape recorder the parameters necessary for commanding the Third Camera unit and, eventually, those required for automatic cartography. Our requirements are

- the identification of the pair of views,
- the central point coordinates of the model,
- the restitution scale,
- the scanning direction,
- the interval between points on a profile,
- the interval between profiles, and
- the coordinates of the point of departure.

Once all these data are known, the operator can proceed with the actual acquisition of the profile. As we see, it is thus an extremely simple operating mode.

It should be noted that a good number of projection-type photoplotters or optico-mechanical plotters, are capable of being equipped with data acquisition systems for profile recording. It suffices, in fact, that they offer the capability of adapting encoders to the *X*, *Y*, and *Z* axes. This acquisition mode has previously been called "ideal" since it allows the digitized profile to be used directly by the Third Camera unit without any intermediate processing. The MATRA type 9400 Digitizer has been designed and developed for this very purpose (Figure 2).

The actual mode of operation of the Automatic Third Camera will now be reconsidered. This operation is performed in four steps:

a) The equipment being on manual mode, the computer makes an initial reading of the tape, stores the coordinates of the control points and the point of departure, determines the slit length (function of the interval between profiles and scale ratios), and calculates maximum ground slopes.

b) After internal orientation of the exposure in the camera, the operator measures monocularly the relative position of setting points on the orthophotographic table and inserts these values into the teleprinter. The computer determines elevation, convergence, outfall, and projection height corrections to be inserted into the plotter.

c) After correction, the operator inserts the scanning direction (*X* or *Y*) and the selected scanning speed (function of maximum slopes) into the electronics cabinet and corrects projection intensity, if necessary, as a function of this scanning speed and of the film used.

d) After loading the film, the projector being off, the operator changes over to au-

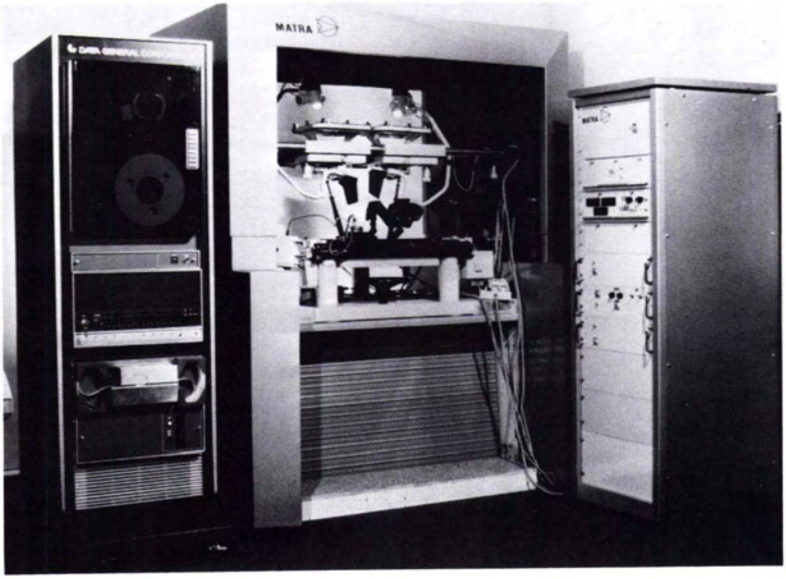


FIG. 2. MATRA Type 9400 Digitizer.

tomatic mode. The slit-holder trolley moves into position automatically at the pqint of departure, the projector lights up, and scanning begins and continues until the end of recording.

The orthophoto is realized.

INTEGRATION OF THE MATRA THIRD CAMERA WITH DIGITAL PHOTOGRAMMETRY

The principal aim of this integration is to acquire the possibility of using the data necessary for controlling the orthophototable off-line for other cartographic applications, or conversely, to allow the orthophotograph to be generated from digitized numerical data for other applications. This remark justifies the choice of the use of a digital profile, as against the possible use of profiles recorded in analog form. The potential advantages of such a choice are

(1) The profile may be digitized on any type of stereoplotter equipped for numerical digitizing,

(2) This same profile may be used for automatic cartography such as slope and sunshine maps or for automatic tracing of contour lines, and

(3) A profile may be obtained from the digitizing of contour lines.

From this notion, stems another acquisition methodology: digitizing of existing contours and analytical transformation into profiles or digitizing of contour lines in conventional photogrammetry and analytical transformation into profiles.

In both cases, does this not form the answer to an accurate altimetry that must necessarily accompany an orthophotography, and that no drop-line or tangential broken line system has been able to give?

CONCLUSION

The possibilities offered by data processing allow the MATRA 910 Automatic Third Camera to be used in fields which, up to now, have been little used in orthophotography.

INCREASE IN ACCURACY

An increase in accuracy may be obtained in several ways: either by treating the recording on line, reducing the slit length by a ratio of ½ or ⅓ with relation to spacing between two successive scans on the original pair of views, or by carrying out this processing previously. The breakpoint effect, often visible in rough terrain, is thereby considerably diminished.

STEREOSCOPIC ORTHOPHOTOGRAPHY

Stereo orthophotos are obtained quite simply, with the same profile line recording, in two run throughs: the first run supplies the true orthophoto, the second supplies the "stereomate", offset with relation to the homologous details by the quantity $X=ZK$.

UPDATING OF ORTHOPHOTOMAPS

Herein lies doubtlessly the most promising aspect of this report—orthophotomaps may be updated very simply (e.g., new towns, roads, etc.). Since the setting process does not rely upon a privileged marker as the case with traditional restitutions ("aircraft" marker), a new flight providing an exposure roughly in line with the original exposure will allow the production of an orthophotomap without having recourse to a new profile recording.

Whatever the final aim, the Third Camera is extremely simple to use, even by an operator little versed in photogrammetry, in electronics, or in data processing, thanks to operations clearly defined by the computer print-out and to the great ease of handling.

Engineering Reports

Business—Equipment—Literature

Gordon R. Heath

Cubic Corporation Issues 1974 Annual Report

Cubic Corporation is engaged primarily in the development, manufacturing, and marketing of a wide variety of products used in five major market areas: electronics; construction; distribution of welding, fire, industrial and safety equipment, gases; two-way radio communications equipment; and transportation.

Research and development in support of these primary products have led to new markets that include: computerized elevator control systems, electronic and infra-red land surveying equipment, microwave positioning systems, establishment of original equipment manufacturers for major distributors of micrographic systems, medical X-ray film handling equipment, and automatic fare collection systems for mass transit.

The financial condition of the company remains solid with working capital at $24,849,000 and consolidated net worth of $24,436,000. Effective January 1, 1974, Cubic's management changed the method of determining cost of inventories in certain operations to the LIFO (last-in-first-out) method. Although the LIFO adjustment increased net losses in 1974 by $651,000, or 29 cents per share, the new method will more fairly present results of the operations.

Fairchild Camera Has Successful First Quarter

Fairchild Camera & Instrument Corporation today reported first-quarter earnings of $3,255,000, or 62 cents per share on sales of $69,757,000.

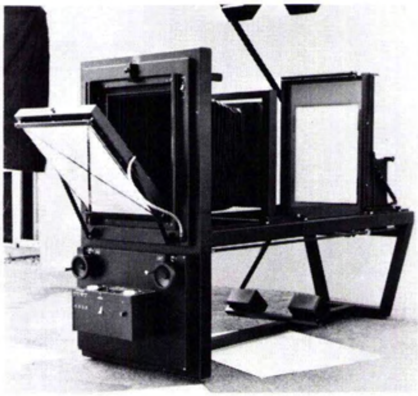
In the comparable 1974 period, the company earned $10,412,000, or $1.97 per share, on sales of $103,817,000. Earnings for the year-earlier quarter included a special gain of $1,250,000, or 24 cents per share, from the sale of land and buildings occupied by a former company division.

Detwiler Industries Locates New Mapping Office

The Metropolitan Mapping Division of Detwiler Industries, Inc., an Alexandria, Virginia based photogrammetric engineering firm, has recently opened offices in Reynoldsburg, Ohio and Charleroi, Pennsylvania.

Acti Products, Inc., Announces New Copy Camera Features

The space-saving, compact process camera model HC23SD by Acti Products now offers precision screw drive as standard equipment for greater accuracy and smoother functioning. The new model has a manually operated screw drive lens board, and copy board carriages utilizing a digital



readout system with focusing charts to achieve repeatability to within 0.002 of an inch. The Acti HC23SD with screw drive is available through a network of dealers in the United States and Canada. Literature is available from Acti Products, Inc., 9852 Baldwin Place, El Monte, Ca. 91731.

LKB Announces Two New Vice Presidents

—Ford Bartlett, President of Lockwood, Kessler & Bartlett, Inc. of Syosset, New York has announced the appointment of two Vice Presidents. William R. Mitchell, will assume the responsibilities of Vice President, Photogrammetric Engineering Operations, and will direct the activities of the Survey & Mapping Division. Mr. Mitchell has been with Lockwood, Kessler & Bartlett since 1968 and had held the position of Sales & Staff Representative. George Alexandridis will head the Planning & Development operations as Vice President. Mr. Alexandridis joined Lockwood, Kessler & Bartlett in 1961 as a senior engineer. He has progressed through the organization as project engineer and department head.