Rocket photography at Inyokern has indeed come a long way since those pioneering days of the California Institute of Technology. Yet, we feel that we are only beginning to learn the science of ballistics photography. As missiles become faster and go farther, instrumentation difficulties multiply, and it becomes evident that much remains unknown and untried. As workers in the program of our nation's defense, we appreciate the valuable assistance and advice given us by the Society of Motion Picture Engineers as we attempt to add to the sum of knowledge in our still infant field of specialized photographic endeavor.

AUTOFOCUSING DESK PROJECTOR

S. N. Samburoff, Ass't. Chief, Engineering Design, Reed Research, Inc. Washington, D. C.

Review

For many years a small, portable projector to facilitate transfer of detail from photographs to maps has been needed. Several engineers and surveyors in the field or in small offices not equipped with the large Saltzman-type projector have constructed workable but more or less crude devices to do the necessary scale changing and projection. Some were little more than a lens, mirror, and light; others were more elaborate. None, however, were auto-focusing, and none were precision instruments.

The projector described by Mr. Samburoff should fill a very real need in schools and in small engineering and field offices where more elaborate and more costly larger projectors are not available. If performance and adaptability of this projector are as satisfactory as its appearance, it will be a valuable contribution to the photogrammetric equipment field.

C. S. Maltby

A COMPACT, portable, reflecting desk projector featuring autofocusing throughout its range of 0.33X to 1.5X, has been designed and developed by Reed Research, Inc., Washington, D.C. under the sponsorship of the U.S. Geological Survey. This instrument fills a need for a small unit capable of projecting relatively larger copy for compilation of new, or revision of existing maps. Designed for field use the projector measures $16\frac{1}{2}''\times20''\times34\frac{5}{8}''$ and, when ready for packing, weighs 56 pounds. It will project any $7''\times7''$ area of opaque copy in sharp focus throughout its range on a horizontal work table. Copy up to $18''\times24''$ can be handled. Figure 1 shows the three quarter view of the projector in use. Figure 2 is the left side view showing mechanical detail.

The base and column assembly, the lens carriage, the lamphouse, and the autofocusing linkage and mechanism comprise the four major components of the instrument. The $15\frac{3}{4}''\times20''$ base serves as a work surface and supports the column assembly consisting of a base casting and two chrome plated, tubular steel columns. The lens carriage and the lamphouse are guided on the main column by ball bearing rollers and are prevented from rotation about the main column by ball bearing rollers acting against the secondary column. Aluminum alloy castings are used throughout.

The lamphouse contains the pressure plate, copy holder and a first surface diagonal mirror. Two 150 watt lamps with $1\frac{1}{4}''$ radius spherical reflectors provide the illumination. Internal light baffles eliminate reflection of the light source through the lens. The lamphouse is of aluminum alloy sheet construction. The lid snaps on and is quickly and easily removable to provide access to the inside of the lamphouse for bulb replacement and cleaning of mirror and pressure plate. Forced ventilation was found to be unnecessary. The cooling air enters

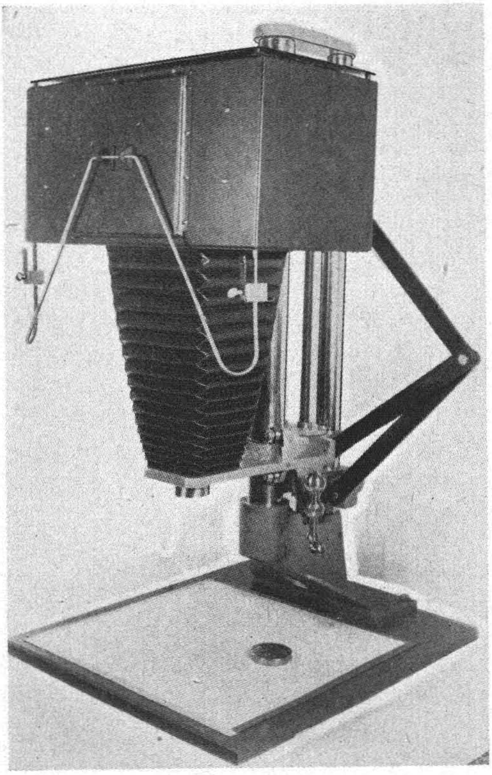

FIG. 1. Three-quarter view of the projector in use.

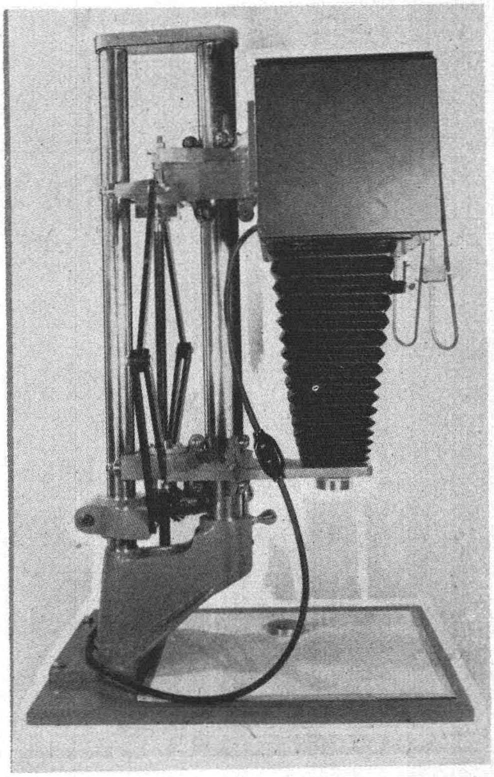

FIG. 2. Left side view showing mechanical detail.

through baffled openings in the floor of the lamphouse and exits through the gap between the lamphouse sides and the lid. The copy holder is spring loaded by means of a spring in the shape of an inverted M. The legs of the spring pass through the holes in the floor of the lamphouse and latch into the holes of the upper flange under their own spring tension. Sliding on the legs of the spring are two copy supports which can be locked in any position by means of thumb screws. The copy holder plate is pivoted at the center of the spring. The entire copy holder assembly can be easily removed by unlatching the spring legs at the top of the lamphouse and sliding the assembly down. The lamphouse is bolted to the lamphouse casting which serves as the upper anchor point for the autofocusing mechanism and linkage.

The lens carriage serves as a mount for a Wollensak $f/4.5$, 162 mm. lens, the driving end of the autofocusing mechanism, and the intermediate anchor point of the autofocusing linkage.

The autofocusing mechanism consists of a Peaucellier inverter linkage, stainless steel lead screw, brass driving nut, miter gears, and hand crank. The non-rotating lead screw is attached to the lamphouse casting in such a way as to have two degrees of freedom in the horizontal plane to insure its constant alignment with the nut. The driving nut, press fitted into two thrust bearings in the lens carriage, is rotated by a crank through a pair of miter gears. A fixed casting on the secondary column is the lower anchor point of the autofocusing linkage.

Turning the hand crank causes the nut to turn on the screw thus moving both the lamphouse and the lens. The screw and nut move the lamphouse and

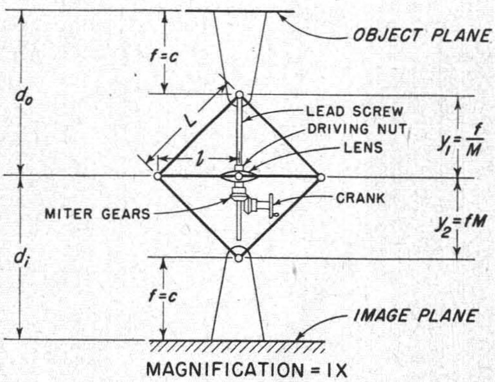

FIG. 3. Schematic diagram of the autofocusing mechanism at 1×.

lens carriage with respect to each other. Meanwhile the Peaucellier linkage maintains the proper relationship between the object and the lens, and between the lens and the image plane by solving the two equations:

$$d_0 = f + f/M$$

$$d_i = f + fM$$

where d_0 is the object to lens distance
d_i is lens to image plane distance
f is focal length of the lens
M is magnification (d_i/d_0)

In the above equations it can be readily seen that the first terms are constants for a given lens, whereas the second terms are functions of variable magnification and are therefore also variable. The equations can be rewritten:

$$d_0 = C + y_1$$

$$d_i = C + y_2$$

where C is a constant focal length of

$$y_1 = f/M$$

$$y_2 = fM$$

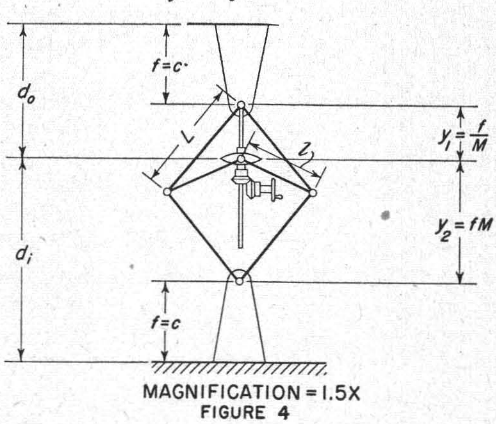

FIG. 4. Schematic diagram of the inverter set at 1.5× magnification.

For any value of y_1 the Peaucellier inverter gives a rigorous mathematical solution for y_2. A schematic diagram of the autofocusing mechanism at 1X as used in the projector is shown in Figure 3. The four outer links are of equal length (L) and can be of any length consistent with the desired geometry (and range of magnification). The length of the two intermediate links (1) is determined by L and the focal length (f) of the lens used. It is expressed by the following relationship:

$$1 = \sqrt{L_2 - f^2}.$$

Figure 4 is a schematic diagram of the inverter set at 1.5X magnification.

Due to its compactness and autofocusing feature the projector is expected to find a wide field of application. It is estimated that the large projection area will enable this instrument to handle about 80 per cent of the work currently done by much larger projectors.

AN ACCOUNT OF SOME RECENT ATTEMPTS TO IMPROVE AIR NEGATIVE QUALITY BY PROCESSING CONTROL*

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ABSTRACT

A processing method is described to obtain the maximum amount of printable detail from aerial negatives that have a wide range of subject contrast. Several developer formulae were tried and the most satisfactory formula was found to be a modified D-76, in which the elon-hydro-quinone ratios were equalized and Kodalk substituted for the borax, resulting in slightly lower contrast but maximum activity. Resulting gammas were in the range of 0.80 to 0.85. A satisfactory series of negatives have been produced under most conditions of exposure.

W. E. VARY

MANY factors affect the processing technique of air negatives. Among these are the type of terrain, the exposure, light and weather conditions, type of printing apparatus, and the ultimate use of the finished print.

The physiography of British Columbia, ranging from its snow-capped mountain peaks reflecting a brilliant sun, to the deepest timbered valleys and canyons beneath a heavy layer of haze and smoke, poses a major photographic problem. In an endeavor to improve the reproduction of this wide range of non-photogenic material through processing control, a series of tests was started to find a developer and a technique which would produce a type of negative containing the maximum amount of *printable* detail over the widest range of subject contrast and exposure conditions. If a negative of this type could be produced, then the photographer would have a useful commodity with which to interest the photogrammetrist.

From past experience it was decided to try a number of fine and semi-fine grain, low contrast developers on a practical comparison basis, with the selection to be made from the finished prints. As all negatives in this unit are enlarged 1.85 X from a 5″×5″ original, the same procedure was followed in the tests and further enlargements to check grain appearance were made to 6 X, this being the maximum routine enlargement by this Division.

* Publication permitted by W. Hall, Chief Engineer, Air Survey Division, Department of Lands and Forests, Victoria, B. C. Canada.