COMPARISON OF THE AGA AND BOFORS INFRARED SCANNER IN AERIAL GEOPHYSICAL EXPLORATION

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INTRODUCTION

The AGA and the Bofors thermal scanners are evaluated on the basis of research requirements centered on water-resources investigations. Also included are comments on its uses in agriculture and on temperatures of man-made surfaces. Infrared real-time scanners are used as aerial reconnaissance tools which provide thermal images of broad areas in real-time presentation. These thermal images display relative temperature differences without immediate regard to absolute temperatures. For operational purposes, the instruments are evaluated mainly on the basis of their ability to provide an image of acceptable quality. That is, no attempt is made to evaluate the use of these instruments for recording the thermal imagery data on magnetic tape or any other data-processing methods. Finally, since it is of utmost importance to have a permanent record of the infrared image presented on the cathode ray tube of the display unit, the ability to obtain a good quality photograph of the image is also considered.

Based on the previous use of the AGA Thermovision in geophysical exploration (Adams and Lepley, 1968), the Bofors Infrared Scanner is compared to the AGA Thermovision for qualitative and quantitative images. The AGA instrument was employed for a period of one month for field operations and the Bofors was employed for only a twelve-day trial period, specifically to test its capabilities.

Area of Tests

The testing of both instruments was performed over the island of Hawaii with additional coastline surveys conducted over the islands of Molokai, Maui, and Hawaii. Urban surface temperatures over Honolulu and agricultural sites were over areas north and west of Pearl City were imaged with the AGA. The AGA was used during the month of June 1968 and the Bofors during late January and early February 1969.

The Bofors was tested at a flight altitude of 10,000 feet often under a 12,000-foot overcast, whereas the AGA was used at an altitude of 11,000 feet under clear skies. Both instruments were also tested at lower altitudes.

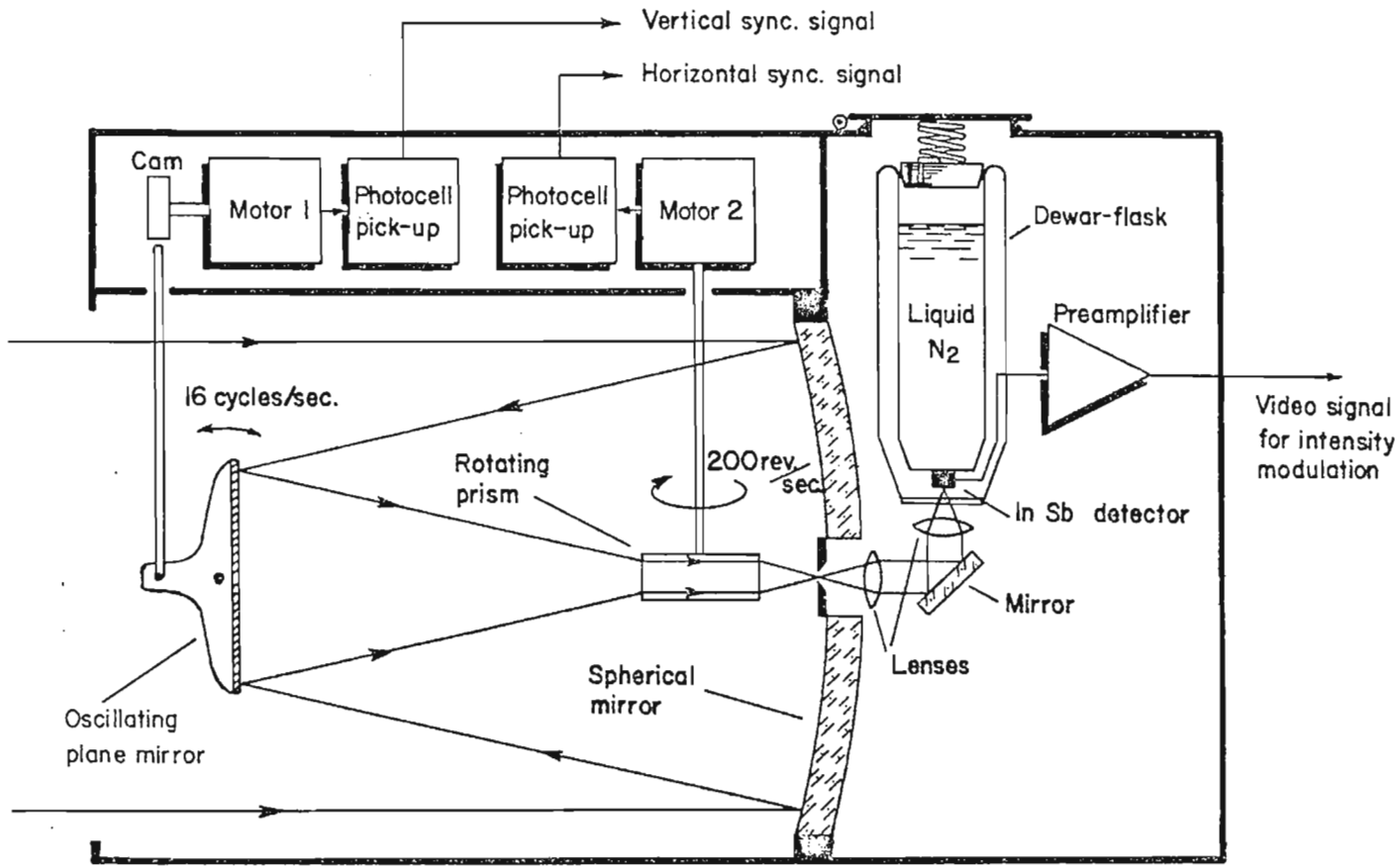


FIGURE 1. DIAGRAMMATIC CROSS-SECTION OF THE AGA THERMOVISION CAMERA.

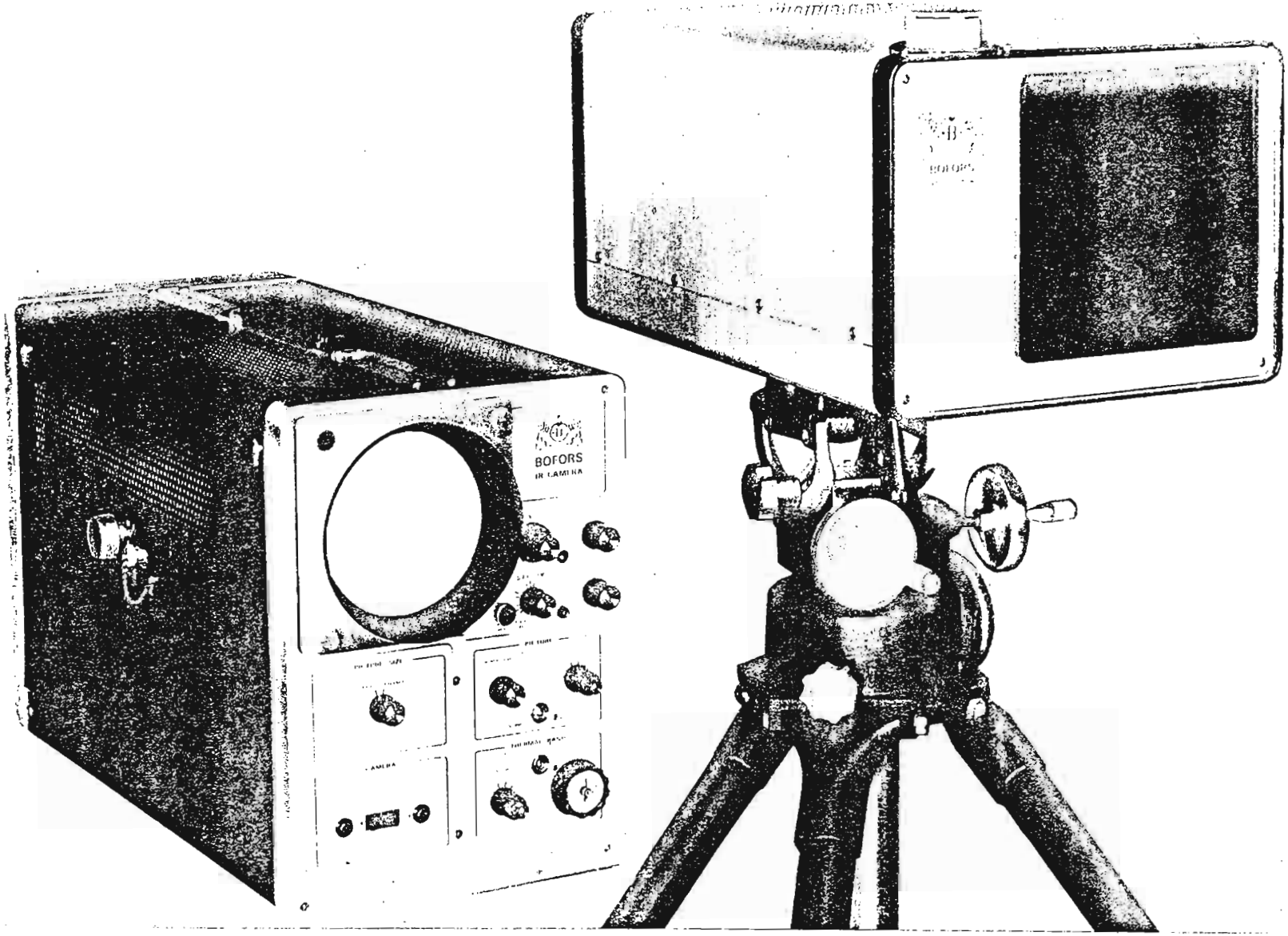


FIGURE 2. BOFORS INFRARED CAMERA.

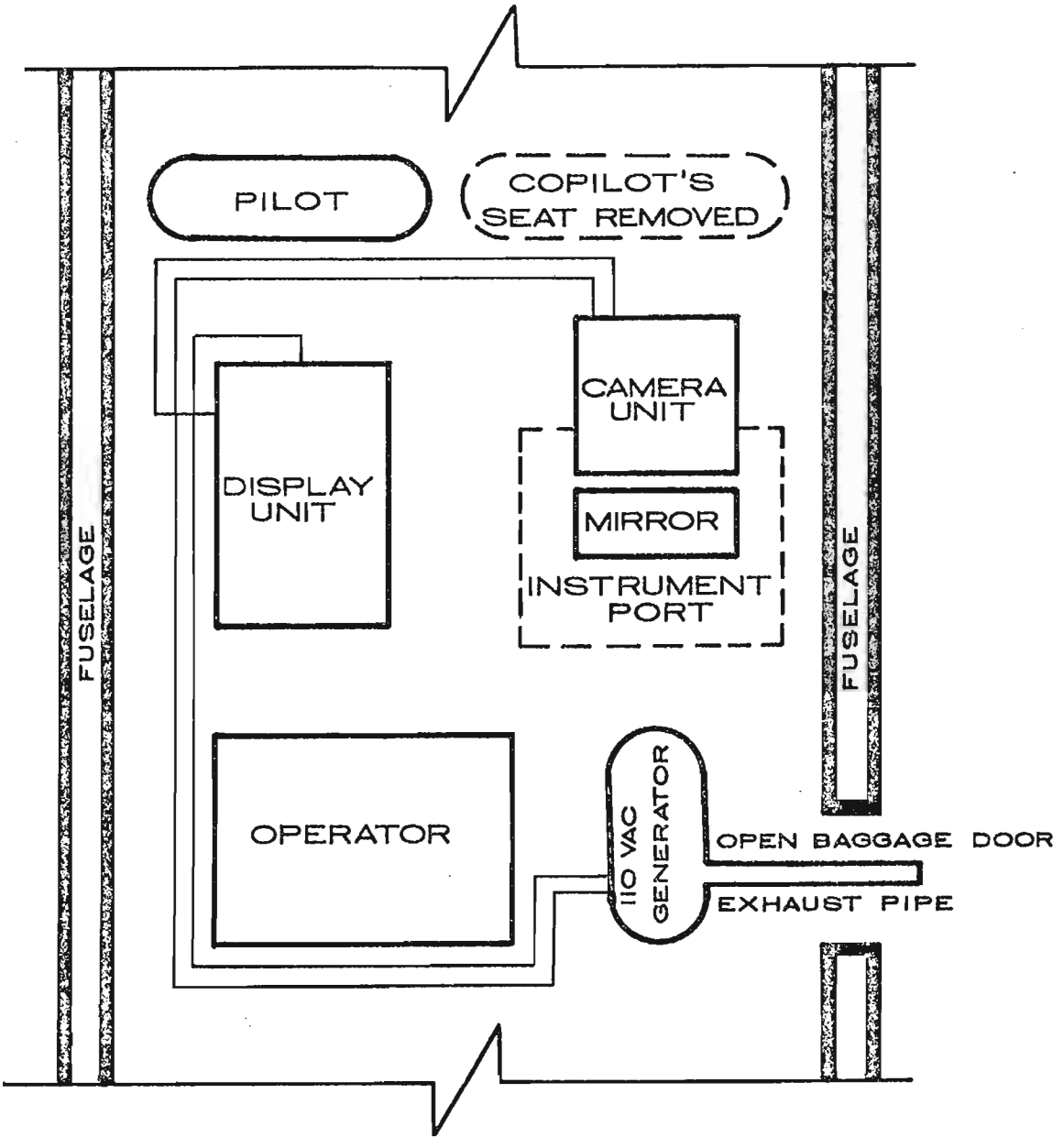
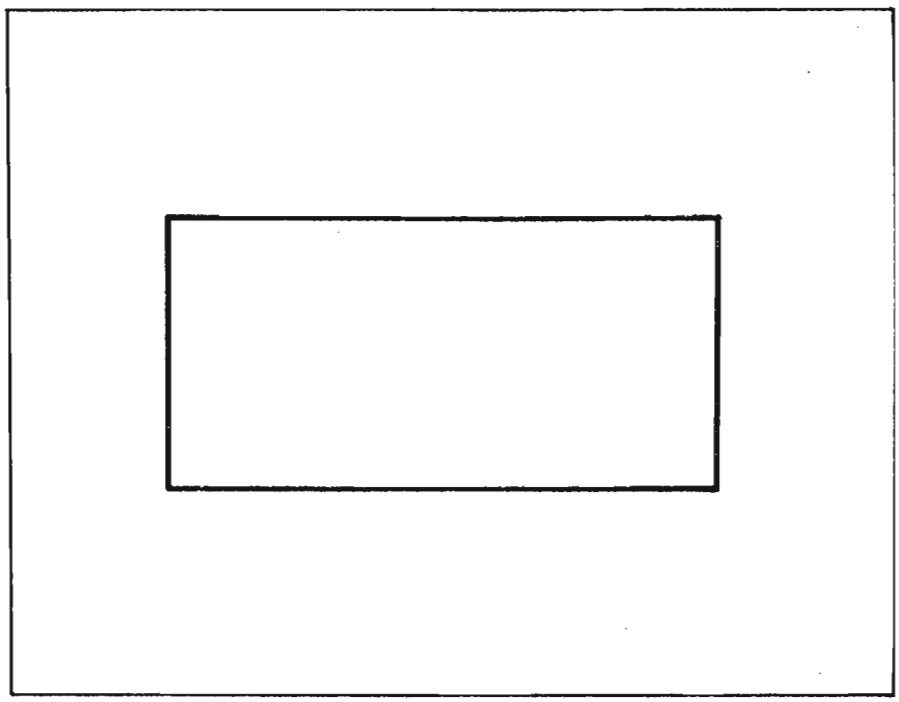
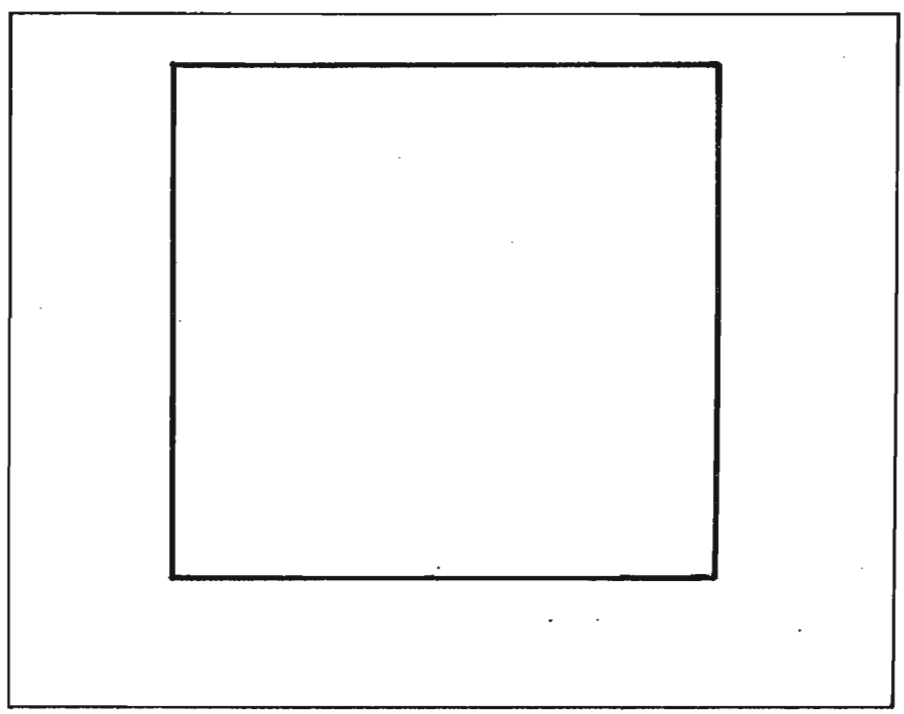


FIGURE 3. CABIN LAYOUT BOFORS SYSTEM.



NORMAL VIEW



EXTENDED VIEW

FIGURE 4. BOFORS IMAGE COVERAGE.

image is in focus at the infinity setting. During optimum operations the AGA is capable of clearly focusing the ocean swell pattern. Focusing of land patterns is also easily accomplished regardless of altitude.

The Bofors, however, has a much more sensitive focus control. Any change to a lower altitude than 10,000 feet requires a change in focus. The optimum focus position becomes increasingly harder to locate with decreasing altitude. In fact, it is impossible to obtain a clear image below 6,000 feet or any fine detail, such as a sugar cane field. The Bofors display unit is equipped with an indicator light to inform the operator when the focus is at infinity. However, this position was never usable. After the indicator light turns on, the operator has to back off to obtain the proper focus. The focusing problem makes it practically impossible to obtain details as ocean pattern, sugar cane, or urban features, and it was a continuous problem during field tests, often not related to the optical system but to the slow scanning rate.

Image Tones

As already suggested, the image tones of the AGA is even and satisfactory. A persistence on the cathode ray tube of the Bofors display unit inhibits a clear image from being formed because of the slow scanning rate and the relative motion of the target. Even with a blue filter supplied by the Barnes Engineering Company, the image is consistently snowy. While the AGA has sharp, smooth tones, the Bofors image is blurred with black and white speckled tones. The persistence, and thus blurring, increases greatly with increased relative motion caused by a decrease in altitude or an increase in relative temperature contrasts caused by a change in filter. Thus anything which might accentuate these factors has a detrimental effect on the image quality.

Filters

The AGA Thermovision did not come equipped with filters. In imaging coastlines, the lack of a method to filter sunlight prevented flying operations from continuing beyond 9 AM. The operator had to continually adjust the black-level control of the AGA to attenuate the adverse

lens was also supplied. Its focus was so critical and so sensitive that it was not used after one day.

	AGA	BOFORS
Optical focus	Infinity focus position satisfactory for all altitudes.	Refocusing necessary at lower altitudes. Over-sensitive focus control.
Filters	No filters provided. Sun glare from ocean spoiled images, but picture tone satisfactory otherwise.	Two short-wave cut-off filters (2.8 and 3.8 micron) provided. Advantageous for removal of solar reflection. Bofors picture tone satisfactory with a filter.
Isotherm Function	Not usable because of non-calibration.	Satisfactory Calibrated
Field of View	5° x 5° Too narrow. Extensive tracking was required by operator to keep coastline view.	25° x 12-1/2° Satisfactory at all altitudes
Resolution	3 min. of arc. Spot size 10' x 10' at 10,000 altitude; 2' x 2' at 2,000. Sufficient to delineate rows of plants at low altitude.	6 min. of arc. Spot size 20' x 20' at 10,000 altitude. Low altitude imagery not possible because of low scan rate. Insufficient resolution for some agricultural imagery.
Black-Level Control	Satisfactory. Enables adjustment of mid-temperature grey tones to obtain imagery of cooler anomalies in a cold ocean adjacent to a hot shoreline.	Did not operate as a mid-temperature grey tone adjustment. Colder anomalies in a cold ocean adjacent to hot shoreline could not be imaged. All ocean water appeared black.

APPENDIX. PHOTOGRAPHS OF BOFORS IMAGERY

(Held in Water Resources Research Center Publications files.)