THE CONCENTRATED ARC LAMP AS A PRIMARY LIGHT SOURCE IN PROJECTION PRINTING

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IN A paper entitled "Air Survey and Photogrammetry in British Columbia" by G. S. Andrews (1) mention was made of the concentrated arc lamp (2). For those interested in the reproduction of the critical definition of the contact print and an improved mass of marvelous detail in a properly printed enlargement, the possibilities of the concentrated arc should be investigated.

Of standard precision enlargements issued so far, reaction by local photogrammetrists indicate beyond all doubt that the advantages of excellent definition far outweigh the disadvantages in the use of this light source. In practical

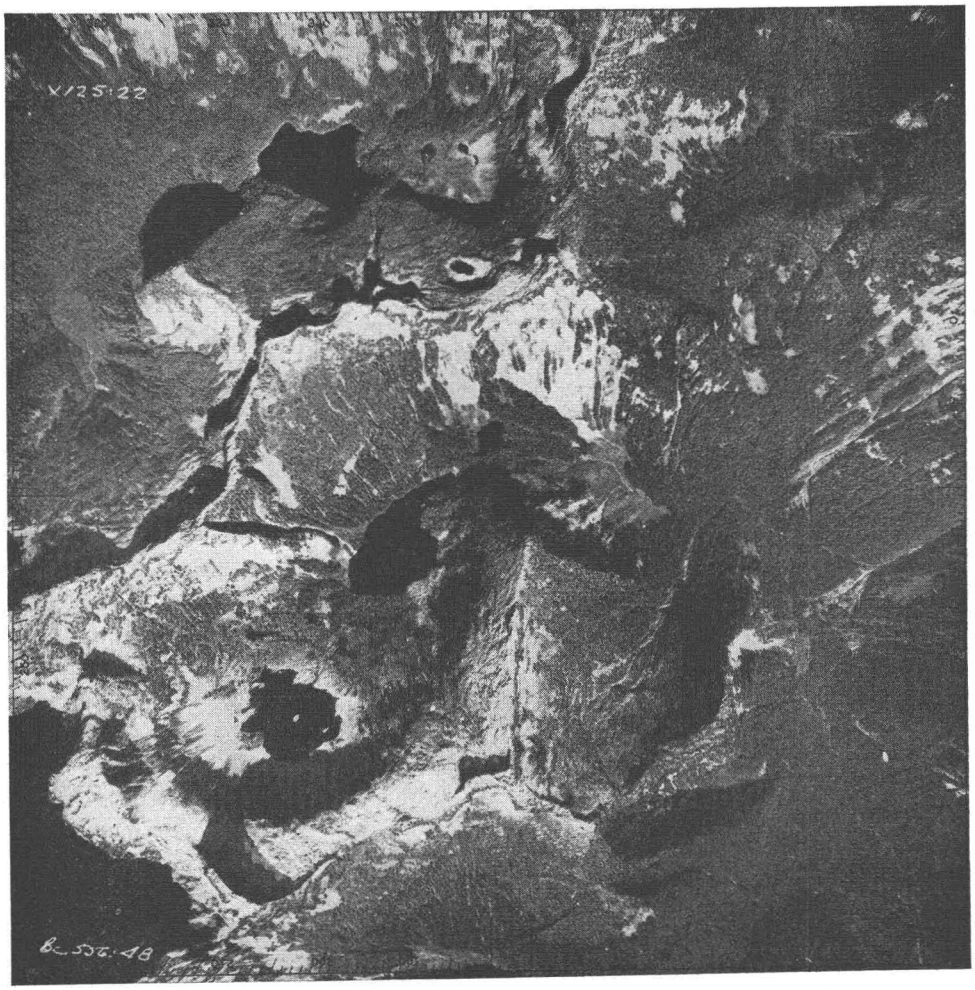

FIG. 1. BC 556-48. A vertical photograph in the vicinity of Jervis Inlet at 17,000 feet altitude covering about 25 square miles. The lower slopes become more fully covered by trees as the terrain drops into the valley. Over the greater part of the original 9×9-inch enlargement each tree may be "isolated."

application, one fixed focus enlarging machine was fitted with a 25-watt concentrated arc lamp for making standard 9×9-inch prints, actually 1.8 enlargements, from 5×5-inch negatives. On a few occasions a 100-watt concentrated arc lamp was used to print very dense negatives. Up to the end of October 1948, some 60,000 1.8 enlargements have been made. The originals of the two vertical photographs shown are standard 1.8 enlargements from a roll of 120 5×5-inch negatives processed in standard fine grain by time and temperature. Although taken over photographically difficult and rugged countryside with violent contrasts in light and shade, both photographs show a wealth of detail not possible with diffusion light sources. Here are some notes covering the photographer's darkroom working detail in the operation of this unique lamp.

In principle, the condenser lenses of an enlarger optical system collect light from the light source, pass the light rays direct, without scatter, evenly through the whole area of the negative to form an image of the negative on the centre of the lens, passing thence to the paper holder. It follows that the smaller the source of light, the smaller the image formed by the light on the centre and most efficient part of the lens, therefore, the finer the definition (3). This principle has been known for many years and some photographic old timers used the ordinary carbon arc lamp in their condenser enlargers because sharp and snappy enlargements resulted.

The concentrated arc lamp has decided advantages over the carbon arc for photographic purposes. An intense light spot only .029″ (0.73 mm.) in the 25-watt lamp and .059″ (1.50 mm.) in the 100-watt lamp is produced. The concentrated arc is enclosed in a vacuum tube and has characteristics similar to those of an ordinary electric lamp. Operation is simplified. The lamps operate on direct current and require something between one and two thousand volts for starting. A power supply unit is necessary for starting and running voltages. The power supply unit is normally situated between the concentrated arc lamp and an ordinary electrical 110-watt outlet.

In any enlarger which has a condenser optical system, the light source must be adjusted closer to or further from the condensers to ensure even lighting at the paper holder. To ensure the best results when using the concentrated arc lamp, it is important also to ensure that the image thrown by the light source is in the centre of the lens and is as small as possible. When the lamp is correctly adjusted, the margin of the lens surrounding the tiny image thrown by the light source, is not in use. The iris diaphragm becomes unnecessary as stopping down does not alter the definition of the negative image or the power of the light at the paper holder.

Since all light rays from the concentrated arc lamp to the paper holder are direct and no stopping down is necessary or possible, the illumination at the paper holder is much more than would be expected of a 25-watt lamp. The ideal exposure limits are between 5 to 10 seconds for enlargements of the best quality. Some trouble may be experienced in making brief enough exposures when very thin negatives are projected. This difficulty may be overcome by placing a K1 glass filter in the light path, close to the bulb of the concentrated arc lamp. On the other hand, very dense negatives are troublesome. Besides taking too long to print, the calibration markings become blurred by halation in the thinner parts of the negative. To speed up the printing of dense or stained negatives, a 100-watt concentrated arc lamp may be used.

As usual with condenser systems, the illumination at the easel is more "contrasty." The concentrated arc lamp emphasizes this and the softer grades of bromide photographic paper with the superior range of tone values may be

FIG. 2. BC 556-115. A vertical photograph; part of a flight in the vicinity of Waddington Glacier at 17,000 feet altitude. This remarkable photograph covers an area of about 25 square miles. Two tall peaks rise and their pattern is seen in the snowfield and glacier flowing at the bottom of the photograph. Note the fineness of detail in every part of the photograph.

used to record the varying shades and details in a correctly exposed and processed negative. In addition, of course, skillful "dodging" may be undertaken to produce excellent enlargements.

It is a good idea to pivot the paper holder at its centre and have the pivot plumb under the optical centre of the condenser-enlarging lens combination. This will enable the printer to check the centre of each negative under the optical centre and square the paper with the negative image where necessary. Further, when the lens is stopped down, an image of the iris diaphragm is thrown onto the paper holder. This phenomenon may be put to good use. The image of the reduced diaphragm in the form of an illuminated circle, should surround the centre point on the paper holder thus indicating whether the light source is centred or otherwise. When a roll of air negative is changed on the enlarger, the quick routine check for dust and accuracy may include closing the diaphragm to ensure the light source is properly adjusted.

There are some disadvantages when using the concentrated arc. Because of the high efficiency of this light source and optical system, every particle of dust, each defect in the negative, the bubbles and striae in the condenser all plague the processing photographer as each is faithfully reproduced in the enlargement. Additional precautions in cleaning all glass surfaces will overcome most of the dust trouble and satisfactory and improved enlargements will result.

The concentrated arc is worth more than an occasional "dusting off" however. If it is agreed that the concentrated arc is a desirable tool in the hands of the processing photographer for the resulting improvement in definition, then action should be taken to produce negatives most suitable to the concentrated arc lamp. The rate of print production and the usefulness of each print to the photogrammetrist is in direct proportion to the quality of each negative.

To implement this requirement, the processing photographers must have the co-operation of the air photographers. Assuming that the air photography is of reasonable standard, the processing photographer must decide on the film processing procedure most likely to bring forth the desirable result.

Bearing in mind the difficulties of the air photographer and the wide range of variables of the terrain and available light, particularly in a mountainous province where many films are taxed to the limits of latitude, or capacity to record printable detail at the over and the under-exposed extremes presented to the film at the moment of exposure, the developing agents used must be those particularly useful in bringing up the shadow detail while retaining the well exposed portions of negative within reasonable bounds of density. Developing formula must be a compromise to ensure in each negative—

(a) No exposure loss.
(b) Exquisite detail of even density throughout, most suitable to the unique projection system where no detail is lost in printing quickly with minimum dodging, on a mass production basis.

Improvements likely to be brought about by the use of the concentrated arc lamp are:

(a) Use of finer grain low contrast film processing.
(b) Use of condenser lenses free of bubbles and striae.
(c) Methods to extract or force dust out of the enlarger.
(d) Ventilation and general efficiency of the darkrooms in which processing photographers labour.

REFERENCES

(1) G. S. Andrews, "Air Survey and Photogrammetry in British Columbia," PHOTOGRAMMETRIC ENGINEERING, Vol. XIV, No. 1, March 1948.
(2) "The Concentrated Arc Lamp—A New Type of Light Source," Western Union Telegraph Co. Electronic Research Laboratories, Water Mill Long Island, N.W. 1945.
(3) R. Child Bayley, "The Complete Photographer," Sixth Edition revised 1920. Methuen and Co. Ltd. London.

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According to the news release of the University of California Press, this concise reference book, designed for engineering students, practicing engineers, research workers, and librarians, enables the technical man to find the key to all research previously published in a particular field by turning directly to the topic. The author, Blanche H. Dalton, is librarian of the Engineering Library at the University of California, Berkeley 4, California.