

(3) A combination of the above approaches may be used. For example, a basic course on photo-interpretation and/or photogrammetry might be followed by specific applications in courses on structural geology, geomorphology, field geology, etc.

Each of the above approaches has its own particular advantages and disadvantages, and these vary with circumstances. Choice of the course to be followed depends on the flexibility of individual curricula, time allowable, equipment available, and qualifications of students and instructors. Whichever course is followed, the important thing is for the basic topics discussed on preceding pages to be treated as fully as possible.

In conclusion, aerial photographic methods are here to stay. Their use is now standard as a method of geologic investigation. Their advantages apply alike to theoretical geology and to applied geology. Their application already has given rise to appreciable advances in geologic knowledge, and now holds much promise for future progress. Their value merits a definite place in the training of the professional geologist. If the teaching of geology is to keep pace with the practice of geology, photo-interpretation and photo-mapping must be included in the curriculum.

## A METHOD OF PREPARING STEREOSCOPIC AERIAL PHOTOGRAPHS FOR REPRODUCTION IN QUANTITY

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THE vertical aerial photographs which have been made in the past few years by several governmental organizations covering the greater part of the agricultural lands of the United States constitute a mine of material useful for instruction in geology and geomorphology and provide also excellent base maps for geological field work. These photographs have been taken with stereoscopic overlap so that the element of relief is fully represented.

For instructional purposes, however, and for use in the field as base maps for geological or geographical studies, the contact prints are difficult to use because the prints must be accurately adjusted to an overlap suited to the eye-spacing of the individual and they must be properly aligned and held rigidly in place by draftsman's tape or otherwise. For use with the simplest type of stereoscope, the lens stereoscope utilizing simple lenses spaced at the same distance apart as the eyes, only part of the stereoscopic area of a pair of prints can be viewed at one time, and for the larger square prints of 9"×9" or 10"×10" size it is still more difficult to view the entire stereoscopic area. Both for instruction in elementary classes and for work in the field these objections are serious.

This brief note is written to describe a method by which a pair of overlapping vertical photographs of any of the standard sizes can be prepared for cheap reproduction in quantity, each pair as a single print showing the entire stereoscopic area of the two prints ready for viewing without any preliminary spacing or alignment difficulties.

The method by which this is accomplished consists in laying the two stereoscopic prints side by side with their centers properly aligned along the line of flight (Fig 1). The prints are then temporarily fastened down and the area including the stereoscopic portion of the two of them is photographed onto a single negative. The photography can conveniently be done with a miniature camera or if desired it may be done with any copying camera. If the negative

is made with a miniature camera, it is then enlarged to a size such that the distance between corresponding points on the photograph of the two stereoscopic prints corresponds to the eye-spacing of the individual, or to a general eye-spacing of about 2.35 inches, which will be satisfactory for most individuals using the lens type of stereoscope. If the photography is done with a copying camera, the size of the negative should be made such that the spacing of corresponding objects on the two prints is as indicated above. When a negative has been obtained by either method, duplicate prints may be made in quantity as rapidly as it is possible to make either contact prints or enlargements from the negatives. On each print the entire stereoscopic area is included, correctly

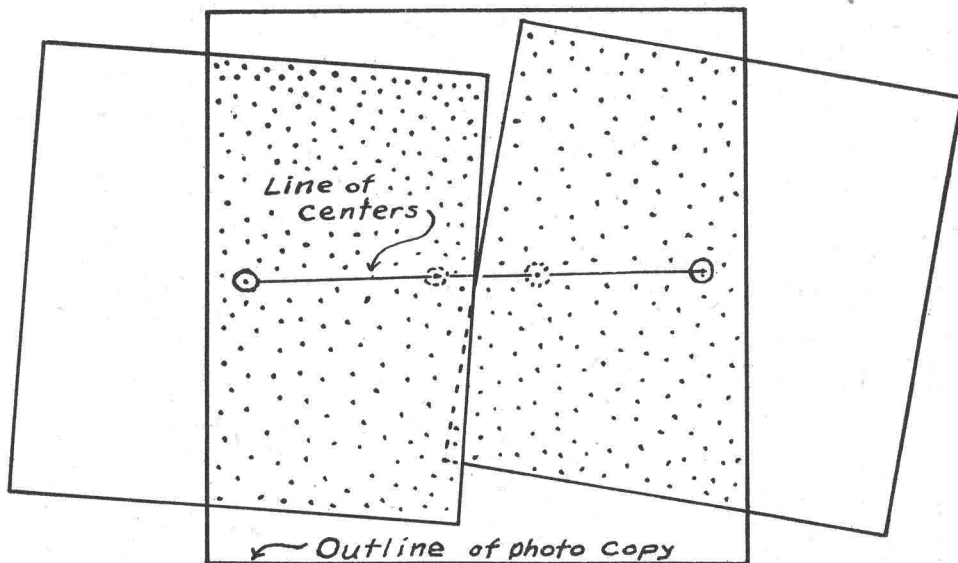


FIG. 1. Arrangement of stereoscopic prints for photographic copying. The stippled area represents the portions of the original prints which are included in the copy.

oriented and spaced so that it is ready for viewing without further adjustment. An example of the resulting print is shown in Figure 2. Should it be desirable to reproduce parts of the original stereoscopic pair on a scale larger than that resulting when the entire area of the prints is copied, it is necessary only to move the prints closer together along the line of centers (always keeping the orientation true) and then copying to a larger scale.

For instructional purposes in elementary geology, it has been found feasible to provide considerable numbers of simple lens stereoscopes, which need not be expensive, and corresponding numbers of copies, suitably mounted on cardboard, of each of the stereoscopic prints desired.

For field work it is a comparatively simple matter to rephotograph the prints of the area about to be covered in the manner just described. The prints are then mounted on stiff cardboard mounts of suitable size for field use. Stereoscopic prints made by this method are on a smaller scale than the originals, but if one is using a lens stereoscope of three or four times magnification the scale is large enough so that the details are still recognizable. These mounted stereoscopic prints are very easy to use in the field because no adjustments are necessary and they furnish excellent bases on which to plot the various geological features. One has no hesitation in marking on them as much as desired because other copies can be reproduced easily. Geological contacts and other geological

features can be correctly identified more easily on the small stereoscopic prints than on the full-sized prints when viewed without a stereoscope. Should one be able to see stereoscopically without an instrument, the smaller prints are much more convenient in the field than those of contact size.

It would seem that this method of using stereoscopic vertical aerial photographs might also have important military uses. For example, a strip of overlapping photographs might be made of a road or similar feature, and the contact



FIG. 2. A stereoscopic pair after copying. Marginal glacial channels near Slaterville Springs, N. Y.  
(Photo by Agr. Adj. Adm.)

prints re-photographed in the way here described. Prints from the resulting negatives could be prepared easily and issued in any desired quantity to officers and others who might have occasion to conduct operations along that road and who might desire to have stereoscopic prints in the field in a form easily carried and easily used.

### COLLEGE AND UNIVERSITY COURSES IN GEOLOGIC USES OF AERIAL PHOTOS, AND GENERAL DISCUSSION

**T**HE following list of courses, although by no means complete, is believed to be representative both of the educational institutions offering such courses, and of the various ways in which the study of aerial photos is incorporated in the curriculum. Information about additional courses offered at other departments of geology and geography will be welcomed, and may be listed in a future issue of this JOURNAL.

INSTRUCTION IN USE OF AERIAL PHOTOS AT THE COLORADO SCHOOL OF MINES

See paper by Rooney and Levings on page 570 of this issue.