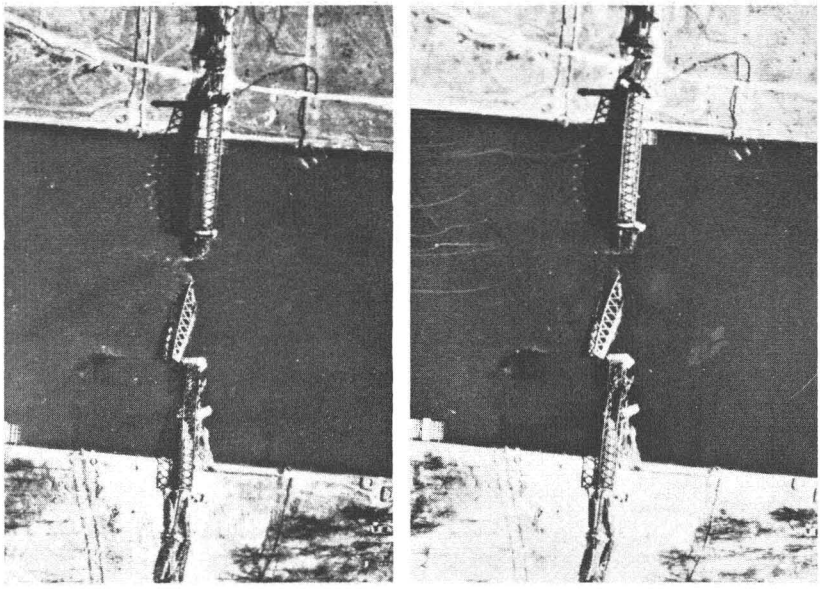

FIG. 1. A photo interpretation candidate who attributes the demolition of this enemy-held bridge to one of our highly successful aerial attacks displays a lack of training and/or experience. Compare with Figure 12. (Department of Defense photo.)

PREFACE

Last year, at our Society's annual meeting, Mr. Robert Sadacca presented an excellent paper entitled "Human Factors in Image Interpretation." In that paper he requested those of us who are engaged in the selection and training of photo interpreters to submit "representative samples" which we have found useful for such purposes. He proposed that our Society's Photo Interpretation Committee serve as a clearing house for this material. My paper is presented in response to that request.*

* More than 50 lantern slides were shown in the oral presentation of this paper. Only a few can be included here; certain others will be found in literature that is cited.

AIDS FOR TESTING VISUAL ACUITY

DESPITE the usefulness of standard vision-testing charts, the principal aids for testing the photo interpretation candidate's visual acuity should be actual aerial photographs. As illustrated by Figure 2, the candidate must be able to discern (1) differences in tone or brightness, as exhibited by the various kinds of ore stockpiled at "A," (2) fineness of detail, such as that needed to recognize the kinds of unloading equipment on the ship at "B," and (3) differences in parallax such as are exhibited by the top and bottom of the smokestack at "C."

Fortunately scientists already have conducted tests which give us some measure of the *average* person's visual acuity for these three parameters, both singly and in various combinations, as illustrated by the diagrams in Figure 6. The author has found photos such as those appearing in Figures 3 to 6 to be very useful in testing the candidate's visual acuity in terms of these parameters. In fact, he considers them to be a far better measure of the candidate's acuity for doing actual photo interpretation work than can be obtained through the use of conventional eye testing charts.

Since ability to perceive tone differences is the main factor leading to the *detection* of an

Aids for the Selection and Training of Photo Interpreters*

(*Abstract on page 329*)

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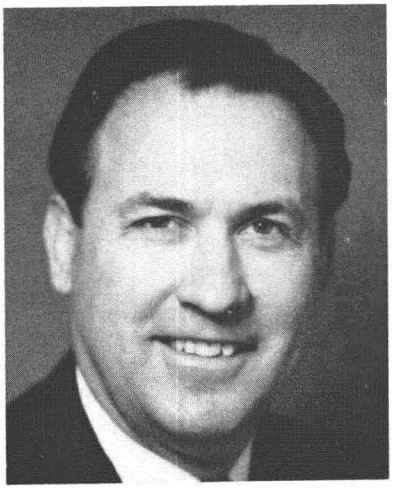
object from its photo image, this parameter is logically tested first, as in Figure 3. The candidate may be asked, for example, to delineate the three shadows that are faintly discernible at *A*, *B*, and *C*, or to trace onto an acetate overlay all edge gradients that he can detect along a straight line between points *X* and *Y*. Actually, these prove to be far better tests of his ability to perceive subtle photographic tone differences than the halftone reproductions of this illustration might suggest.

Figure 4 is a portion of an oblique photo used to test the candidate's ability to discern both fine tone differences and fine detail. The snow geese which he is asked to enumerate in various portions of this photo appear as progressively smaller images from foreground to background, and at varying contrasts with their backgrounds, e.g., in the annotated areas at *A*, *B*, and *C*.

The lower part of Figure 5 shows a three-dimensional model which the author has found useful in testing the candidate's simultaneous acuities for all three parameters, tone contrast, fineness of detail and stereoscopic parallax—as required in most photo interpretation problems. In the top photo of the model, squares, circles, rectangles and their three-dimensional counterparts (the objects casting shadows) are shown in an orderly array. They are imaged at high-contrast on one panel, at medium-contrast on another, and at low-contrast on a third. This model has been photographed both on sunny days (for maximum shadow effects of the three-dimensional objects) and on overcast days, when the advantage of being able to discern shadow detail has been eliminated. Precisely oriented vertical photos have been taken of the model from various "flight altitudes" (actually from windows at various floor levels in an adjacent multistory building). The range in photographic scales which this procedure provides expands the range over which fineness of detail is portrayed in the series of test stereograms.

Some of the test photos are taken with the camera in optimum focus, while others are



ROBERT N. COLWELL

* Presented at the Annual Meeting of the Society in Washington, D. C., March 15–21, 1964.

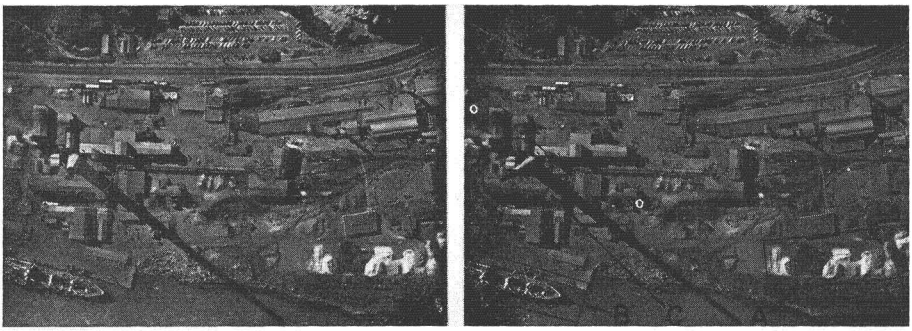


FIG. 2. Stereogram illustrating the need for testing a photo interpretation candidate's visual acuity for differences in tone or brightness, fineness of detail and stereoscopic parallax, as explained in the text.

taken with the camera purposely thrown out of focus by known amounts, thus permitting a test to be made of the criticalness of image sharpness for the perception of fine detail by each candidate. The overlapping vertical photos (needed for presenting this model to the candidate as a stereogram) are taken with the "air base" varying by specified and accurately measured amounts. The series of stereograms thus obtained permits each three-dimensional object in the target array to exhibit a *range* of parallax values, all other image quality factors being kept constant. By these various manipulations, absolute control is maintained over the three primary factors (tone contrast, sharpness and parallax) which govern the interpretability of images.

The left half of the upper part of Figure 5 merely provides standard resolution targets and gray scales which would permit a more sophisticated investigator than the author to employ his own preferred measures of image quality in terms of sinusoidal response curves, gamma values and the like.

It will be noted that sometimes the various objects in the three panels are arranged in an orderly fashion (i.e. in straight rows, ranging from smallest to largest, with the two-dimensional and corresponding three-dimensional objects in juxtaposition and in identical locations in each of the three panels). Additional photos have been taken after the objects have been "scrambled" on each panel into a highly disorderly array.

After preliminary tests of the candidate's visual acuity have been made using stereograms taken of the target in *orderly* array, he is given photos of the *disorderly* array, for which only the investigator has "ground truth." He is then asked to study vertical photo stereograms of several of these disorderly arrays and to indicate (1) the position

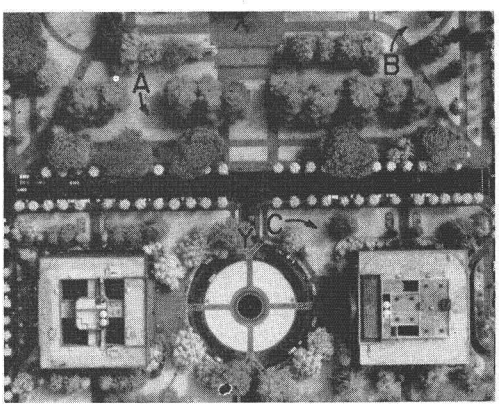


FIG. 3. An aid for testing the candidate's visual acuity for tone differences. One's attention is drawn to the tree shadows, in addition to other items.

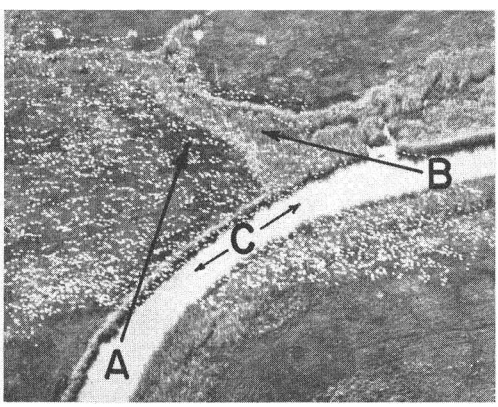


FIG. 4. An aid for testing the candidate's visual acuity for a combination of tone differences and fineness of detail. He is asked to enumerate the snow geese in various portions of the photograph.

on the panel of each blob which he can detect, (2) the two-dimensional configuration of the blob and (3) its three-dimensional configuration.

The oblique stereogram appearing in the lower part of Figure 5 is included merely to show one of the random arrangements that have been used in administering this threefold test. The gridded background facilitates reporting of what the candidate thinks he sees.

Most photo interpreters are called upon from time to time to interpret various kinds of aerial *color* photography. Consequently tests should be made of the photo interpretation candidate's visual acuity for various combinations of hue, value and chroma. For this purpose the author has found it helpful to employ a target array which is similar to that shown in the upper part of Figure 5, but in which the panels and the 2-d and 3-d objects placed upon them exhibit appropriate color characteristics. It has been found that the human eye may suffer from a peculiar kind of color blindness when looking at very small images on color photography. The candidate's limitations in this regard can be better tested by using color photos of the target array than by using conventional test charts for color blindness.

It is important to determine how each candidate's visual acuity is affected by fatigue. To this end, from time to time during a normal photo interpretation work day, he may be asked to interpret stereograms showing various orientations of this target array, both in black-and-white and in color.

ABSTRACT: *Among the factors to consider in selecting a person to perform photo interpretation work are his visual and mental acuity, his background of training and experience, and his degree of motivation. The curriculum used in training the selectee should teach him the geometry of aerial photographs, the specific photo recognition characteristics of important objects and conditions, and the basic techniques involved in the photo interpretation process. Examples are presented which, in the light of these considerations, have been found useful for the selection and training of photo interpreters.*

AIDS FOR TESTING THE CANDIDATE'S MENTAL ACUITY

On pages 129 and 130 of the MANUAL OF PHOTO INTERPRETATION (American Society of Photogrammetry, 1960) thirteen measures of a photo interpretation candidate's aptitude are listed and briefly described. Most of these measures apply to the candidate's *mental* acuity rather than to his *visual* acuity. All of the examples considered in this section can be placed under one or another of these thirteen measures.

Most tests of the mental acuity of a photo interpretation candidate should seek to determine not only whether he can solve various problems, but also how *rapidly* he can solve them. In judging his mental acuity we need not limit our tests entirely to aerial photos; some aerial photo examples certainly should be included, however.

With reference to Figure 7, how much time does the photo interpretation candidate require in order to decipher the message which appears on the soles of Red Skelton's shoes? The required time will depend largely upon (1) his mental alertness in noting that Red's feet are crossed, (2) his ability to make the necessary transposition of words, and (3) his ability to "reason out" what the missing letters must be, based in part on the mental alertness which he has exhibited on the many occasions in the past when he has been exposed to signs bearing the standard wording "Do not disturb."

As illustrated by Figure 8, even cartoons can provide a useful test of the candidate's mental acuity. On viewing the *top left* cartoon of this figure, the candidate's initial reaction may be that the football player on the right end of the bench is from the team that is winning the game, while all of those to his left are from the team that is losing. But given sufficient time, the candidate notices an electric cord spiralling down the pole, probably to an electric blanket which only the grinning football player enjoys. That this is the real point of the cartoon is further suggested by the evidence of a strong and presumably cold wind.

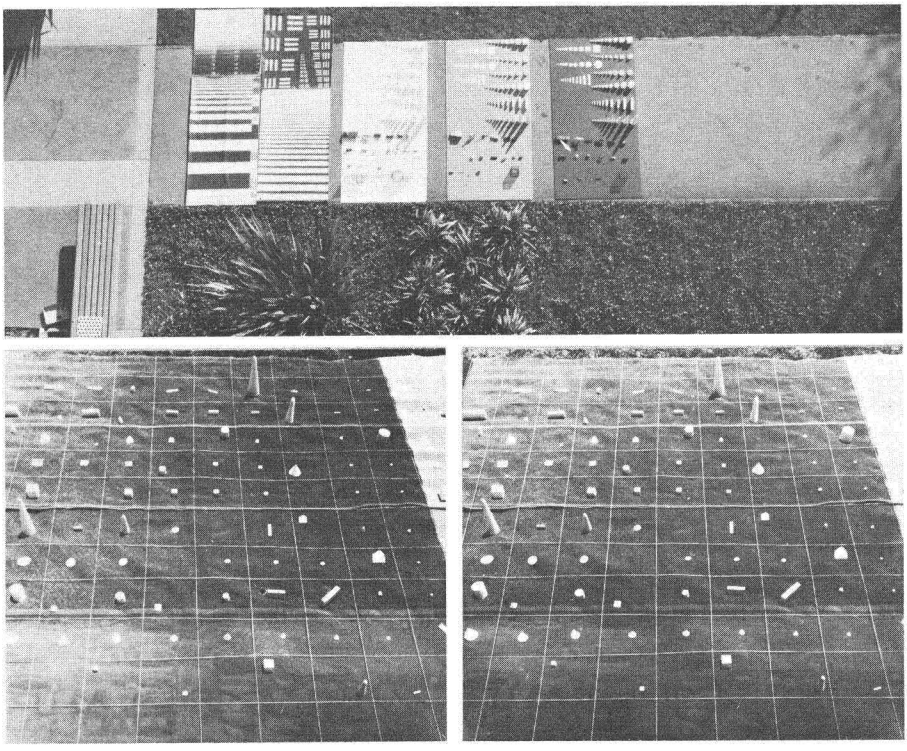


FIG. 5. Three-dimensional models such as these aid in testing the photo interpretation candidate's visual acuity for tone contrast and stereo parallax, as explained in the text.

Similarly, the cartoon appearing in the *top right* portion of Figure 8 provides an interesting measure of the candidate's mental acuity. How long does it take him to determine that the hapless man is saying (in effect) "Madam, you have just impaled me on your broomstick!" Initially, the candidate may misinterpret the top-most package that the woman is carrying to be a window in the back of the store; if so, comprehension of the impaling catastrophe will come to him more slowly.

The cartoon comprising the *lower right* portion of Figure 8 has a caption which reads: "Find a boy, his wool cap and mitten, a skate on a boot, a bell, a book, a mouse, a cat, a girl, and the dog she didn't catch." Can one's ability to pass this juvenile test be related to his ability to discern objects, often randomly oriented and partly obscured, as imaged on aerial photographs? A friend of mine who is a highly competent photo interpreter, and a pilot as well, answers that question with a strong affirmative based on an experience with his own two sons, aged 9 and 10. The one who is highly proficient at finding hidden objects in drawings such as this was also proficient in recognizing all of the home town landmarks (fire stations, supermarkets, used car lots, and his own school, church, and home) when Dad took him on his first airplane ride; the other son lacked proficiency in both tests; in fact during the airplane ride he couldn't identify the things his brother so excitedly was pointing out and, somewhat in disgust, he napped during most of the flight. In other respects, however, the brothers appear to have equally high mental acuity and motivation. Further studies, of course, must be performed before we can determine the extent to which this kind of test provides a useful measure of a candidate's mental acuity for performing photo interpretation work.

The cartoon comprising the *lower left* portion of Figure 8 has a caption which reads, "O.K. What's the situation in a nutshell?"—a question which the Chief of Police apparently is asking the rookie cop in the lower left corner of the scene. Since the "situation" will depend greatly on the frame of reference, it may be revealing to ask the photo interpretation candidate to assume two frames of reference: (1) that in which food supplies for this embattled city are limited (the over-

turned milk truck assumes additional significance under these circumstances, and probably should be reported first); and (2) that in which the interrogating officer is actually

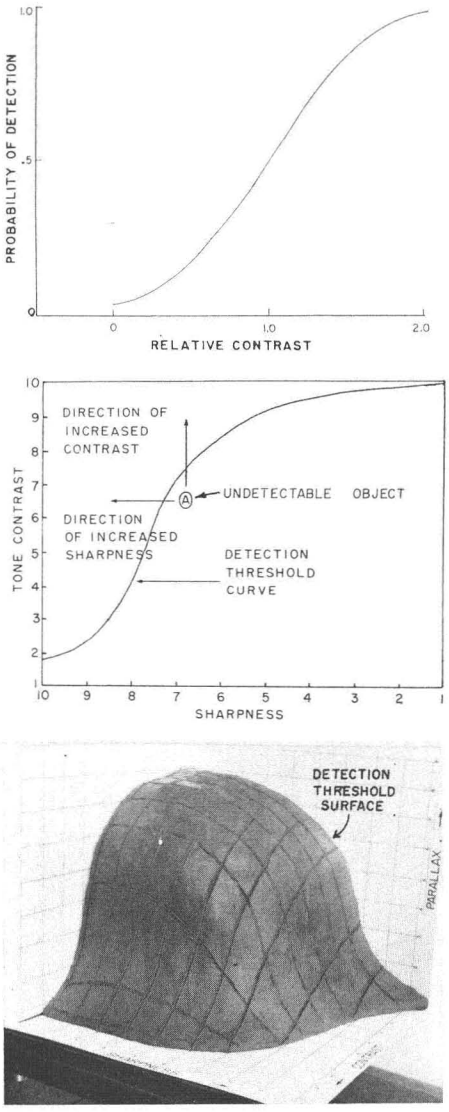


FIG. 6. The probability that a photo interpreter of average visual acuity can detect an image is related to image contrast (top) to contrast and sharpness (center) and to contrast, sharpness and stereo parallax (bottom). The top diagram is adapted from Blackwell (1946) and the center one is adapted from Macdonald (1951). In the bottom diagram all the photo images that fall beneath the detection threshold surface have a combination of tone contrast sharpness and parallax characteristics which make them indetectable to the person of normal visual acuity. For any photo interpretation candidate a similar detection threshold surface can be defined by plotting the results of visual acuity tests given to him using target arrays of the types shown in Figures 3, 4 and 5.

FIG. 7. The time which a photo interpretation candidate requires to decipher the message appearing on the sole of Red Skelton's shoes provides one measure of his mental acuity for the photo interpretation task. (Courtesy of *TRUE* magazine.)

the commander of a dwindling tactical air force which has the mission of helping to restore some much-needed law and order in the area. Given this new frame of reference a rookie intelligence officer of proper mental acuity will sweep aside the many irrelevant disasters shown in this scene and promptly report to his chief, "one of our pilots is in trouble" (as he points to the man suspended from a light pole by his parachute), and "one of our aircraft is presumed lost" (as he points to the wreck in the street).

Whatever the merits of cartoons, including their ability to provide some much-needed comic relief, they obviously have important limitations when they are used to test a candidate's mental acuity for the photo interpretation task. A cartoon is at least one step removed from the realities of a photograph and the candidate is likely to read into a cartoon even more than the cartoonist had intended, thereby complicating our problem of evaluating the candidate's mental acuity from the results of such tests. Thus, if we ask him to report all errors or incongruities he can detect in the cartoon of Figure 9, he may quite correctly report that parts of the stairway bannister are missing, that a flower pot is suspended upside down in mid-air, and that a crescent moon is shown rising at midday (an astronomical impossibility). But in his enthusiasm for performing the assigned task he may become so "error happy" that

he also reports certain features that are not necessarily incongruous. For example, it may seem incongruous to him that there is a picture on the television screen even though the electric cord is disconnected, but the disconnected cord may belong to the lamp which is atop the TV set.

Similarly, the candidate may consider it incongruous that the coats are suspended in mid-air, instead of hanging on the coat rack, but the coats may be hanging from wall hooks, one of which can be seen just to the left of the coats. He may even report the impossibility of the children playing ball by moonlight. If, however, we assume that the moon has been accurately portrayed as a crescent (in which case the wall clock is in error), then the sun is just a few degrees below the horizon, so the children may be playing ball by twilight—a common after-dinner practice in some areas.

Figure 10 provides an example of the value of our using actual aerial photographs as aids in testing the candidate's mental acuity. He is merely asked to report on the activity that is taking place in this area. He may first identify the rice paddies and note that some of them are located in topographically adverse sites, indicating a very high intensity of land use in the area and the probability that the photography was taken somewhere in the Orient. This tentative conclusion will facilitate his further interpretation of the area. While studying the objects on the water, he pays close attention to the details of their shadows and correctly identifies the objects as junks. The most critical test of mental acuity comes next. The candidate of suitable mental acuity should discover, sooner or later, that the junks are in *pairs*, as evidenced both by their spacing and by the curved line that connects each vessel with its mate.

FIG. 8. For a discussion of the value of these cartoons in measuring a photo interpretation candidate's mental acuity, see text.

Once he has made these observations he studies these objects, not as randomly spaced blobs, but as pairs of junks, each pair operating in an area somewhat apart from the areas in which the other pairs are operating. As the candidate asks himself what kind of activity might account for this phenomenon, he almost certainly will consider *fishing* as a distinct possibility. He notes that the relative positions of the two junks are somewhat different in one pair than in another, and that the shape of the barely discernible loops seen to be connecting them varies accordingly.

He can thus reconstruct with remarkable clarity the successive steps employed by net fishermen in "closing the loop," even though he may have had virtually no prior experience relative to this type of activity. He can also make certain useful inferences from this photography as to kinds of food consumed by the natives, their sailing capabilities, the depth of the water, and even the nature of its flora and fauna.

Patience and judgment also are required to a high degree when performing certain photo interpretation tasks. All of these attributes are required to a high degree in delineating stratification boundaries of vegetation types, soil types, urban area categories, and a host of other classifications. Consequently the candidate might well be given some preliminary instructions for stratifying such features from aerial photos; then he should be given a day-long photo interpretation exercise in which he must apply these stratification principles with both patience and judgment while maintaining high visual acuity. Figure 11, when free of annotations, is representative of the kind of problem that might be given the candidate during such a test.

Additional aerial photographic tests of the candidate's mental acuity will be found in a technical paper by Sims and Hall (1956).

Aids for Determining the Candidate's Background of Training and Experience

The enemy-held bridge appearing in Figure 1 obviously has been demolished. But the military photo interpretation candidate who attributes this to one of our highly successful aerial attacks clearly is suffering from a lack of training and experience in both bomb warfare and bomb damage assessment. He is not disturbed, apparently, by the fact that

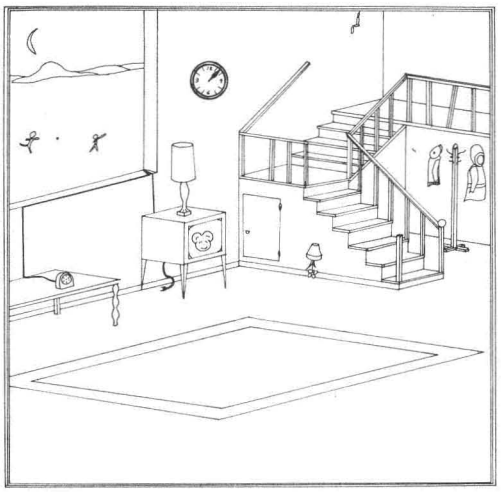


FIG. 9. An aid for testing the candidate's ability to differentiate between true incongruities and those which appear to be incongruities, but aren't. The military photo interpreter who is inclined to become unduly suspicious of everything he sees on photos of enemy-held territory can profit from a test such as this.

all of our bombs seem to have scored direct hits on the bridge. The candidate with only a little more background, however, knows that the ratio of hits to misses in an aerial bombing attack is more nearly typified in Figure 12. He therefore is much more likely to draw the correct and highly significant conclusion (as he studies the enemy-held bridge in Figure 1), that the enemy himself has used carefully emplaced demolition charges to blow up his own bridge. Realization of this important fact is likely to lead the photo interpreter to a much more accurate evaluation of the enemy's intentions.

Similarly, even when a photo interpretation candidate having excellent visual and mental acuity attempts to interpret aerial photos of high quality, he may fail to identify objects with which he has had no experience.

Aids for Determining the Candidate's Degree of Motivation

The author has found that Figure 13 is excellent material for motivating some foresters and geologists, but not others. Soil and vegetation boundaries obviously can be delineated more quickly and accurately in five minutes from careful study of this area than in several days of arduous field mapping. A dike, along which important mineral deposits are likely to be localized also is readily detected on this photo; yet this was over-

FIG. 10. As explained in the text, a photo interpretation candidate who can report correctly on the activity taking place in this area, exhibits evidence of acceptably high mental acuity for the photo interpretation task. (Department of Defense photo).

looked when the area was field checked by skilled surface geologists lacking the photos, because the topography and vegetation severely limited their visibility. Actually, the dike was first detected on photography of an earlier date of the area, and by the time this most recent photography was flown, numerous test holes had already been drilled and a highly profitable mining operation had been started along one portion of the dike, as indicated by the annotations.

One able photo interpreter has stated that he was motivated to this profession as a result of reading Chapter 12 of our Society's MANUAL OF PHOTOGRAMMETRY (second edition); still others have been similarly motivated by reading our Society's MANUAL OF PHOTOGRAPHIC INTERPRETATION. It is quite probable that while some reference materials will motivate one photo interpretation candidate, other materials will motivate another one; consequently several such materials might well be used in measuring the candidate's degree of motivation. If however he fails to express genuine interest in *any* of a well-assorted group of such examples, then it is quite probable that he will not become a successful photo interpreter.

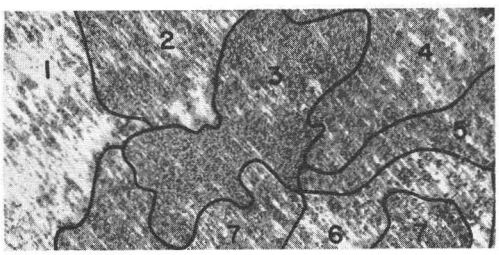


FIG. 11. Patience, judgment and high visual acuity throughout prolonged work periods are attributes required to a high degree in delineating stratification boundaries for vegetation types. This photo, when free of annotations, is representative of test photos which might be given the candidate. On it, after preliminary instruction he would be expected to draw vegetation boundaries that would be at least roughly comparable to those appearing on this annotated solution, thus delineating the area into volume-per-acre classes.

In photo interpretation, as in many other arts and sciences, the candidate will never be an outstanding success unless he is highly motivated toward the type of tasks he will be expected to perform.

On page 126 of the MANUAL OF PHOTOGRAPHIC INTERPRETATION, a suggested line of inquiry is presented which serves to test the candidate's degree of motivation toward certain kinds of photo interpretation work.

An excellent study of factors affecting the motivation of various kinds of workers has recently been published by Myers (1964).

AIDS FOR TEACHING THE BASIC GEOMETRY OF AERIAL PHOTOGRAPHS

Suitable aids are needed not only for selecting candidates for photo interpretation work, as described above, but also for training the selectees so that they will be able to do justice to the important assignments that soon will be given them. Among the most important

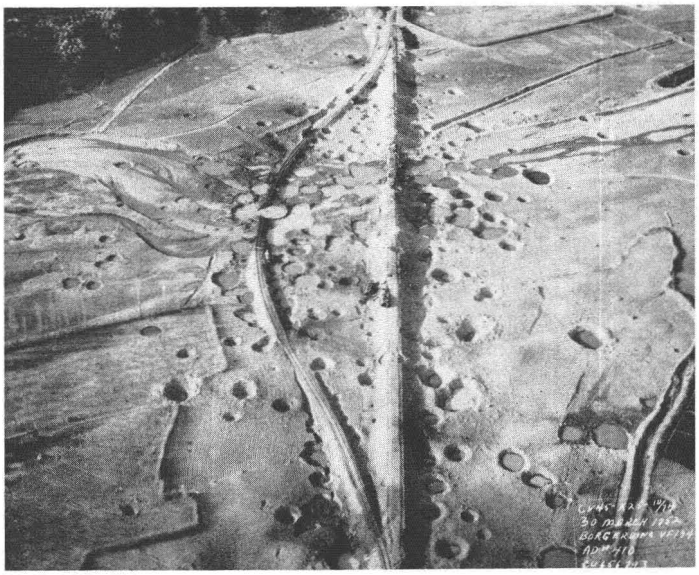


FIG. 12. In testing a candidate's suitability for certain kinds of photo interpretation work he might first be given this and other aerial photos showing demolition of enemy installations by our air units. Then, at some later session, he might be asked to interpret photos such as Figure 1, as explained in the accompanying text.

of these training aids are those which will give the selectees a clear understanding of the geometry of aerial photographs. It has been aptly stated that "pictures don't lie"; but they can be very erroneously interpreted by a person who fails to comprehend the basic geometry (Figure 14) of the perspective view, as recorded on an aerial photograph. Among the publications which contain illustrations of this important point and aids to solving the problem are those by McNeil (1954), Colwell (1963) and the forthcoming third edition of our Society's MANUAL OF PHOTOGRAMMETRY.

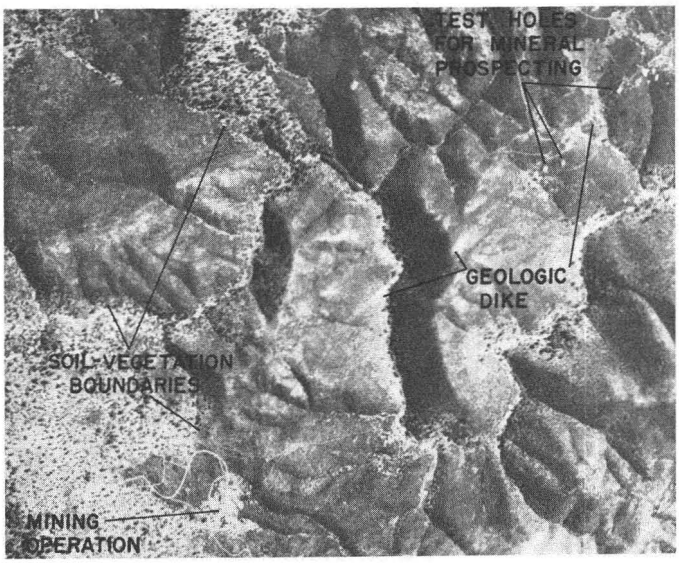


FIG. 13. This aerial photo is one of a large series that should be interpreted in detail *for* the candidate in order to determine which kind of photo interpretation work, if any, is most likely to motivate him. For further explanation, see text.

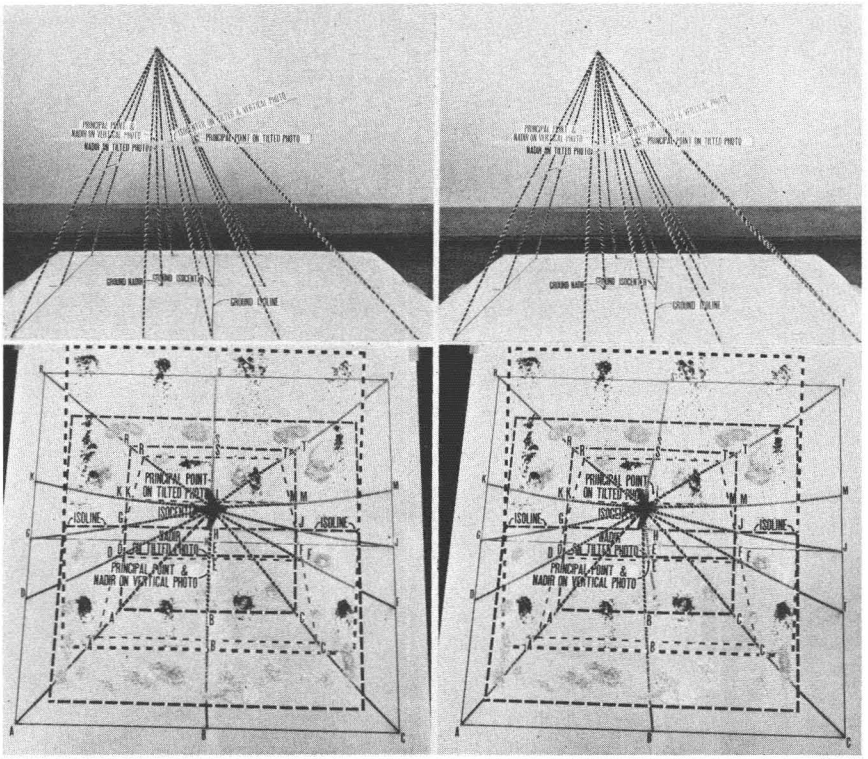


FIG. 14. Three dimensional models such as this are of great value in teaching the basic geometry of aerial photographs. When it is not feasible for the photo interpretation trainee to view the model itself, a mere stereogram of it, as shown here, can be a valuable training aid.

AIDS FOR TEACHING THE SPECIFIC RECOGNITION CHARACTERISTICS OF IMPORTANT OBJECTS AND CONDITIONS

First the trainee must be duly impressed with the fact that features which are most conspicuous in the ground view may be quite inconspicuous in the aerial view, and vice versa, as seen in Figure 15.

Given proper realization of this important fact, the trainee is ready to learn the specific recognition features of the various objects and conditions which he is likely to be called upon to interpret. One very useful aid for accomplishing this objective is the aerial photo interpretation key, but only if the key has been properly constructed. For example a photo interpretation key to the vegetation types of wildland areas usually should contain four elements: (a) carefully selected oblique views which, by covering large expanses of terrain, will reveal the ecological site preferred by each type; (b) stereograms of these same vegetation types, made from vertical aerial photos that have been flown to essentially the same specifications (in terms of scale, film-filter combination, season of year, time of day, etc.) as those which the photo interpreter ordinarily will be called upon to interpret; (c) a word description which sets forth in some systematic fashion the photo recognition features that are discernible in this conventional photography; and (d) a statement, for each vegetation type, as to its significance in relation to the type of study for which the interpretation is being performed. One thoroughly tested and time-honored key which contains these four elements was published by the U. S. Naval Photographic Interpretation Center (1945).

It is very important that the examples given in any photo interpretation key be correct ones, and that statements as to the photo image characteristics of the objects and conditions to be identified be completely accurate. As a training aid, an inaccurate key or one that merely lists photo image characteristics without contrasting them may be worse than no key at all. Examples of good photo interpretation keys, and papers on the procedure for constructing such keys (as ap-

proved by the U. S. Interservice Committee on Photo Interpretation Research, Keys and Techniques) appear in a publication of the Research and Development Board (1953). Some good papers dealing in rather general terms with the advantages and limitations of photo interpretation keys were published as a symposium by Roscoe et al. (1953) and updated by Bigelow (1963).

It has been aptly stated, although in a much different context, that "the true nature of things is best indicated by contrasts." It is equally true that contrasts are best perceived *between pairs* of things rather than *among many*. The type of photo interpretation key which best exploits these important facts is the dichotomous or "two-branched" key. Consequently, where feasible of formulation the dichotomous type of key should be used as a training aid.

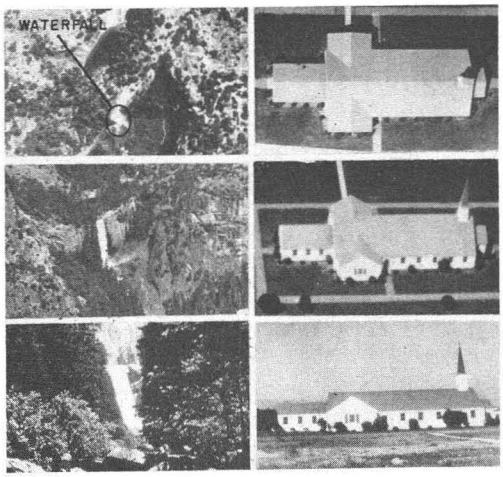


FIG. 15. One of a series of aids used in teaching the trainee how to relate the familiar ground view to the oblique and vertical views that are presented to him on aerial photographs.

AIDS FOR TEACHING THE BASIC TECHNIQUES INVOLVED IN THE PHOTO INTERPRETATION PROCESS

In attempting to extract all pertinent information from a set of aerial photos, the trainee should employ search techniques which will ensure that he carefully searches each area once and once only. Perhaps the first training aid needed to this end is one which will convince the trainee that unless he employs the proper search techniques he almost certainly will overlook important features which he should have reported. Figure 16 provides one example which I have found useful in this respect. I merely ask the trainee to determine the number of aircraft carriers appearing in this stereogram. Almost always the answer given is "5," simply because the trainee has failed to search the entire area and therefore has missed the largest carrier of all, the one resting in dry dock.

The trainee also should be taught at an early date how to use the technique known as "convergence of evidence." Here again, training aids in the form of actual aerial photo examples are needed to illustrate the value of this technique. To a limited extent, the value of the convergence of evidence technique was illustrated in our earlier discussion of Figure 10 of this paper. The technique is better illustrated, however, on page 131 of the aforementioned publication of the Research and Development Board (1953).

The best aids for teaching certain kinds of photo interpretation techniques are properly-prepared training films. Trainees learn more rapidly and retain more lastingly the techniques that they actually see demonstrated in films than those they merely read about or hear discussed.

The films are also far better than lectures or laboratory demonstrations for permitting a large class of trainees to see fine details, such as must be seen if they are to comprehend certain photo interpretation techniques. In addition the training films can be viewed repeatedly by slower students until all the trainees have mastered all aspects of a given technique. Even the most patient instructor, lacking such films, might become completely exasperated before that goal had been achieved.

Finally, to ensure uniformity in the performance of certain photo interpretation procedures, and uniformity of reporting certain photo interpretation data, a high degree of uniformity in the instruction is essential. To this end, the use of a standard set of training films will ensure that the same techniques will be taught to all trainees whether they be in one class under one instructor, or in many classes under many instructors, and even in classrooms that are widely separated geographically.

A series of five training films demonstrating most of these advantages was recently prepared under auspices of the Pan American Institute of Geography and History under the general title "Aerial Photo Interpreta-

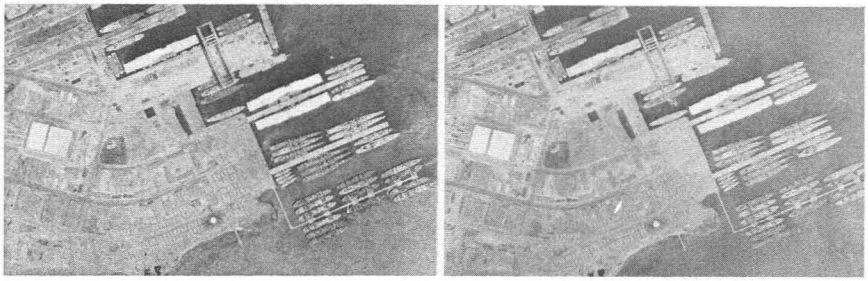


FIG. 16. An aid for teaching the trainee the importance of using proper search techniques. How many aircraft carriers appear in this stereogram?

tion for the Discovery and Evaluation of Natural Resources." These films are quite generally available for either purchase or loan through the Map Information Office, U. S. Geological Survey, Washington 25, D. C. Although the primary purpose of the films was simply to demonstrate the value of aerial photos as aids to the making of natural resource inventories, each film in the series conveys a great deal of information on specific photo interpretation techniques.

Possibilities for the use of teaching machines and programmed instruction techniques in the training of photo interpreters currently are being investigated by Albert G. Hahn of the U. S. Forest Service. Several of the advantages of training films, as listed above, are equally inherent in teaching machine presentations. In the Forest Service program, instruction is provided by magnetic tape recordings which are coordinated with a 35 mm. projector using slides that illustrate points referred to in the narration. Trainees may work alone or on a team; each may proceed at his own pace. The instruction is so programmed that the trainee is able to critique his own photo measurements and interpretations by comparing them with "school solutions."

If the instructional material is properly prepared, much of it can be effectively presented merely in the form of written exercises and accompanying stereograms. Notable among the effective aids of this type is a "Training Plan for Developing Basic Techniques in Forest Photo Interpretation" recently developed by Moessner (1960).

It is revealing to enumerate the thirteen problems comprising this training plan, as they constitute a good summary of the more important basic techniques which forest photo interpreters, and many others as well, should master. They are: stereo perception test, positioning photos for best stereo vision, recognition of ground cover conditions, determining photo scale, determining project scale and flying height, determining bearing and distance on aerial photos, determining relative elevation by parallax wedge, measurement of tree and stand heights by parallax wedge, estimating crown diameter and crown coverage, estimating board-foot and cubic-foot volumes on sample plots, dot sampling for area determinations, direct volume estimation from aerial photos, measuring slope percents, and planning road nets from aerial photos.

CONCLUSION

Much of the foregoing discussion has pertained to the use of rather elaborate equipment in the selection and training of photo interpreters. It must be emphasized that the equipment is of little or no value as an instructional aid unless the material which it presents has been properly selected.

Therefore it is considered doubly important to conclude this paper by citing a photo interpretation aid; while some would consider it far too mundane for our twentieth century technology, it has nonetheless been hailed by others as "the most significant development of the last ten years in the field of photo interpretation." I refer to the University of Illinois Stereogram Series which is designed "to help fill the need for high-quality aerial photography that can be reproduced inexpensively for instructional use." Each stereogram has been prepared to give good stereoscopic effect and to permit measurement of differential parallax. Of even greater importance, the stereograms of this series illustrate a wide variety of natural and man-made features for which "ground truth" has been painstakingly established.

The Committee on Aerial Photography of the University of Illinois serves as the repository and clearing house for this excellent set of aids for the selection and training of photo interpreters.

Any organization, even our American Society of Photogrammetry, can be no better than the individuals comprising it. Consequently, as we look to the future, we realize that there are few undertakings in which our Society has a greater stake than that of successfully selecting and training its future photo interpreters. Through the increased use of aids such as those discussed in this paper we should be able to make great improvements in our ability to accomplish this vital task.

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New United States Wall Map

A wall map of the United States, showing Federal lands and historical boundaries, has just been printed by the Geological Survey and may be purchased from the Government Printing Office.

It details for the first time on a single sheet of paper national parks and monuments, national forests, Indian reservations, wildlife refuges, public lands, and historical boundaries, in addition to cities, towns, rivers, and lakes. Approximately 7,500 names of cultural, hydrographic, and historical features are positioned on the map.

14 Million Year Old Marine Mammal

The 14-million-year old bones of a "paleoparadoxia"—a 1-ton, 9-foot-long aquatic mammal somewhat similar in appearance to a sea lion—are being prepared for study in a laboratory at the Geological Survey's Menlo Park, California field center, the Department of the Interior reported.

Discovered on October 2, 1964 in an excavation site at Stanford University, Palo Alto, California, the rare specimen is the first of its kind discovered in North America, and only the second one identified anywhere in the world.

Charles A. Repenning, a specialist in vertebrate paleontology with the Geological Survey, and now responsible for the collection and preparation of the specimen which was made available by Stanford University officials, said that the specimen may well be one of the more significant fossil discoveries on the North American continent.