Use of the Aerial Photograph

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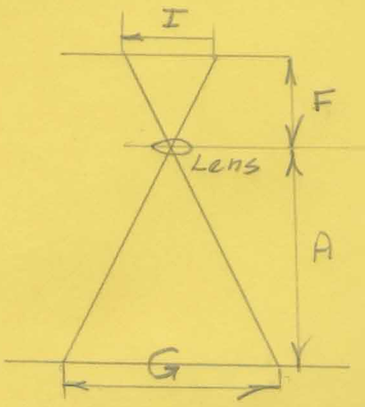
Pro Seminar
Prof. Lohr

Aerial photography is a tool that has great potetniality in the pursuit of Civil Engineering. This morning I should like to discuss some of the applications of the aerial photgraph, and the information that can be gleaned from their study.

The fundamental idea in any surveying operation is the measuremnt of horizontal and vertical distances. The large amount of labor and time that is consumed by using conventional metods of surveying can be cut down by the use of aerial surveying techniques.

First, the question of horizontal measurement arrises. Can horizontal distances be measured from an aerial photograph?



The diagram shows two similiar triangles. The lens of the camera converges the rays of light reflected from the earth.

(A) in the above drawing is known, it is the altidude of the lens, (I) is the length of the image which can be measured and (F) the focal length of the lens which is known.

(G) is the horizontal distance desired and it is readily apparent that it can be solved for by simple geometry.

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If the altiude is not known but a distance on the ground is known the same simple proprtion will give the answer.

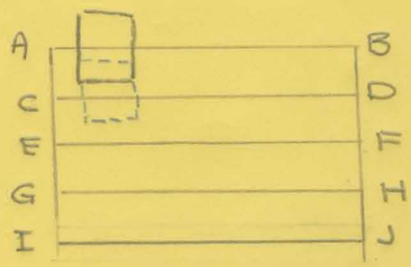
This proportion is $\frac{I}{F} \approx \frac{G}{A}$

The proof that vertical distances can be computed is complicated but I shall show you that it works on the same principle as the steriopticah.

The steriopticah uses two adjoining photographs taken at a set distance apart. The eye adjusts for the difference in point of view that these two photographs present and an illusion of depth is given.

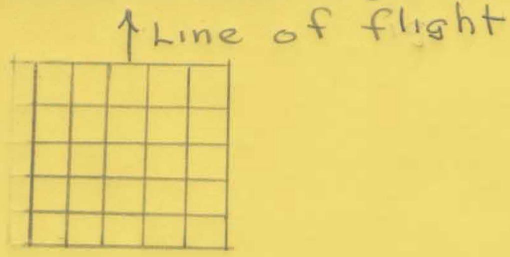
The angles of view that are presented in these photographs can be measured and the relative elevation of various points on the photograph can be accertained.

The fundamentals of mapmaking are simple. Say a large area is to be mapped.



Flight lines are set up so that there is a side overlap of photographs of 40%. (Theses lines are AB, CD, Etc. On the drawing) This overlap is easily computed as the altidude to be flown is known, the focal length of the lens is known and the size of the film is known. Therefore the the amount of ground covered can be computed as shown previously.

There is usually a general map available to give points where lines of flight should be started in order to get the 40% overlap.



When a map is not available one can used a ground glass etched as a grid as shown in the sketch, a lens causes an image on the glass.

An object is picked up on one of the lines that is in the same direction as the line of flight and this follows on the ground glass in the direction of the line of flight. On the next pass over the area this original object is offset the required distance for proper overlap and another object is picked up for offsetting on the third pass.

For over lap in the other direction an object is picked up on the ground glass and the time interval is noted for the object to travel the required distance on the ground glass. An interval timer is then set for this time and a continuous series of pictures is taken.

After the photographs are processed they are laid on a board so as to present a general layout of the terrain. This layout is called an uncontrolled mosaic.

For accurate work a system of know points must be available.

For example a system of Coast and Geodetic bench marks can be used. These can be located in relation to each other and the errors between them can be averaged out. Since the relative elevations can be ~~gotten~~ obtained from a photgraph there must be some known elevation to carry the actual elevations from, known bench marks give known elevations and by this method contour maps can be developed.

In a recent edition of the Philadelphia Inquirer (This article is enclosed) an article appeared telling of the Marine Corps landing at Roche Point, Newfoundland in a mock invasion.

This article went on to say that the Department of Civil Engineer at Cornell, under Dr. D. J. Belcher, disclosed the following information about conitions that would be encountered. This information was gotten solely from aerial photographs. Part of the analysis was based on geo-morphology. Geo- morphology is the science dealing with the relation of land form to sub-structure.

The type of beach was predicted (this prediction included the fact that trucks could successfully operate on the beach. (The lack of information about the use of motorized equipment at Iwo Jima with respect to the inability of the beach to support this equipment cost 20,000 wounded and 4,000 lives.), the depth of water was predicted also the drift of the tide was predicted.

This article continues by saying that by these methods there is a tendency to eliminate such things as test borings for subsoil drainage, for heavy duty traffic, landslide possibilites and generally help solve other similiar problems. Poor sentence

Furthermore flash floods can be predicted, borrow pits can be located most economically and the type of material in the borrow pit can even be specified

I have tried to outline rather briefly the use of a new tool in Civil Engineering, and I hope that I have succeeded in demonstrating that aerial photography is an aid that bears personal investigation.

Science Takes a Beachhead

Experts Map Landings From Air Photographs

By John M. McCullough

THREE SCIENTISTS, none of them a member of the armed forces, told the Marine Corps precisely and in detail what kind of beach the assault landing team would encounter when it stormed ashore inside Roche Point at Argentia, Newfoundland, in simulated "cold weather" amphibious operations last Monday.

The prediction of beach conditions was made hundreds of miles distant from harsh and barren Argentia, in a quiet office of Cornell University's Department of Civil Engineering, solely upon the basis of aerial photographs.

The same predictions, appropriately employed, would have warned the Marine staff which planned the operation that field radio communication would be almost completely inoperative because of the high absorption of low-power high-frequency radio waves by the rocky coast, rich in low grade ferrous and other electricity-conducting ores.

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ALTHOUGH the amphibious assault was primarily a training maneuver, the lessons of the opera-

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Science Takes a Beachhead

Air Photographs Depict Terrain

By John M. McCullough

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tion—from the time when the mighty force of ships put to sea until the simulated landing 10 days later—are bound to have tremendous repercussions on subsequent military planning and technological research and development.

The beach prediction was a dividend from the relatively new science of geo-morphology — that is, the science dealing with the form and the structure of the earth. Actually, it is not so much a new science as it is a sandwiching of several very old sciences.

One of the Second World War lessons, which neither the Navy nor the Marine Corps ever will forget, was the total and costly miscalculation of the form and structure of the beaches on Iwo Jima, which the Marines assaulted and took in February, 1945, at a cost of more than 20,000 casualties, including more than 4000 killed in combat.

Motorized equipment bogged down helplessly in the light volcanic ash of which the beaches are composed, exposing equipment and men alike to the merciless fire of Japanese mortars, artillery and small arms. Then and there, the Navy and its assault arm, the Marines, determined they would not make that mistake again.

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AFTER considerable preliminary study of the problem, a contract was negotiated in February, 1947, by the Office of Naval Research with the Department of Civil Engineering of Cornell University, of which Dr. D. J. Belcher is head. His two assistants in the work are R. J. Hodge, a former officer in the "Seabees" (naval construction battalion) and H. C. Ladenheim, both of whom are research associates.

Working solely from aerial photographs of the Argentia beach and the surrounding terrain, Dr. Belcher and his associates advised the Marine Corps that the beach would be composed of water-smoothed glacial debris, principally granite and varying in size from very fine to large.

It was predicted that heavy motorized equipment—bulldozers, generator trucks, amphtracks, medium artillery, jeeps and the other motorized equipment of a beach assault team—would encounter no difficulty in debarking from the landing craft and crossing the beaches.

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IN CHECKING the predictions, of vital importance to the success or failure of the simulated exercise, one of the team—"Chuck" Ladenheim—found that they had erred only in the depth of the beach. That was due, it was discovered, to a variation in the scale of the aerial photographs which had been used as the basis for the analysis.

The analyses are made from a variety of well-known geological phenomena. A rocky beach, composed of sand or gravel or rock, is very sharply demarked in an aerial photograph; one composed largely of fine silt, such as that of Iwo Jima, has a vague and foggy outline, due to suspension in the surf of the fine particles.

The fracturing of rock, revealed by the aerial photographs, indicated the beach would be composed mainly of granite debris. The fact that the "strand lines" of the beach—the lines marking the effect of tides and storms upon the beach shelf—were regular and light indicated that the beach material was unconsolidated and well-drained, so that no marshy underfooting would be encountered. The regular, paralleling strand lines indicated the beach material was heavy, thus double-checking the conclusion that it was composed of granite.

The strand lines, photographs disclosed, became less regular on the beach as they extended from west to east, indicating that the drift of the tide was to the east—another factor of great importance as relating to the approach of the assault boats, disposition of supplies on the beachhead, and so on.

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LIKE many other research contracts sponsored by the armed forces, Cornell's geo-morphological studies will have an even more important application to peace-time projects than to military.

The purpose of the Cornell study is not to make an index of the beaches of the world, but rather to prepare a technical manual on beach "accessibility and trafficability" as a text for the rapid training of beach-prediction teams in the event such a force should be required by national emergency. That is the national security aspect of the study in which the armed forces are interested.

However, geo-morphological analyses of terrain will have almost incalculable usefulness in peace-time operations. Such an analysis will tend to eliminate the necessity for extensive, costly and not always fully satisfactory test borings to establish the nature of sub-soil for purposes of drainage, heavy-duty traffic, landslides, erosion, and other similar problems.

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GIGANTIC Isely Field, on the island of Saipan in the Marianas, was constructed in the summer of 1944 as a base for B-29s in their long-range strategic bombardment of Japan. Geo-morophologists, studying the deep erosion fissures in the foothills of Mount Topatchou, rimming the sea shelf upon which the field was constructed, could have told the engineers that the field would be swept by "flash" floods during the rainy season, thus enormously adding to the labor and expense of maintenance. Any commercial airfield so constructed would be a mighty poor investment.

Engineering studies for airports, highways or construction projects requiring hard "fill" will be assisted by aerial surveys. It would be smart to locate a needed "fill" for a highway, for instance, in close proximity to an abundance of fill material, to cut down construction costs.

Aerial surveys, expertly analyzed, will give the answers in a matter of days, thereby bypassing extensive, time-consuming and expensive local engineering studies.

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FAILURE of the short-range field radios—the type of communication upon which an amphibious assault commander largely depends to deploy his forces—could have been predicted by geo-morphology through identification of large deposits of iron and copper ores of low grade in the terrain.

Since field radio communications must be universal in employment, whatever the conditions of terrain, the Marine Corps has a nice problem for the armed forces' research and development men. Can a high-power, low-frequency radio set, impervious to terrain absorption, be manufactured sufficiently compactly to permit its use by mobile forces? If not, what alternate type of communication can be substituted for the faulty low-power high frequency sets?

That is only one of the questions the assault and supporting forces are bringing back from Newfoundland.