

Photo Interpretation and Photogrammetry in World War II

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"The nation with the best photointerpretation will win the next war." General Oberst Baron Werner von Fritsch, Chief of the German General Staff, November 1938.

WHEN GENERAL VON FRITSCH made that statement, Germany was the world leader in military photo interpretation. Germany had organized and trained a cadre of military photo interpreters to a degree of expertise unknown in any other country.

In the United States, by contrast, the Office of Naval Intelligence, in response to Admiral J. King's 1940 memo "Are We Ready?," presented a very bleak picture—the intelligence service was lacking in funds, personnel, material, and training. The U.S. Army and the U.S. Army Air Corps were in similar predicaments. The United States, in truth, had no organized aerial photographic intelligence organization. While some in the Navy advocated enlisting the resources of the film industry in Hollywood, Vice Admiral Robert L. Ghormley, the U.S. Naval Attache in London, proposed that the U.S. Navy send qualified naval officers to observe what the British were accomplishing in photographic intelligence techniques.

In the spring of 1941, Lt. Commander Robert S. Quackenbush, Jr. arrived in London and, having observed the highly successful results obtained by the British in gathering information from aerial photography, recommended a concerted effort be made to establish a U.S. Navy school as soon as possible to train officers in the art and science of photo interpretation. On 12 September 1941, the Chief of Naval Operations approved the establishment of a Photographic Interpretation School to be located at the U.S. Naval Air Station, Anacostia, Maryland. Lt. Comdr. Quackenbush was named Officer-in-Charge and Captain Charles H. Cox, USMCR, and Capt. Gooderham L. McCormick, USMCR, were named Executive Officer and Chief Instructor, respectively (Figure 1).

In mid-1941, the U.S. Army had sent Captain Harvey C. Brown to attend the British photo interpretation school at Medmenham. Upon returning to the United States, Capt. Brown helped organize the Army Photo Interpretation School of Harrisburg, Pennsylvania. General Henry "Hap" Arnold had also sent Major George W. Goddard of the Army Air Corps to visit and observe the British system.

The procurement of adequate personnel and the preparations for general mobilization presented major problems for all the services in the early 1940s. The Navy advocated bringing back all retired officers who were physically and temperamentally suited for intelligence duties. Reservists with ge-

ography, geology, forestry, surveying, and architectural backgrounds were actively sought by all services. General "Hap" Arnold, in late 1940, authorized Major Goddard to confer commissions on a number of qualified civilians and bring back other specialists into Army reserve units.

The outbreak of war on 7 December 1941 meant an immediate acceleration in the procurement and training of photo interpreters and photogrammetrists. The military turned to those governmental and private agencies that had made extensive use of aerial photography. The Agricultural Adjustment Administration had systematically photographed the nation's crop and grazing lands, and the Forest Service had photographed the nation's timber reserves; the Geological Survey produced topographic quadrangles and geological maps with the aid of aerial photos, and the Soil Survey mapped the soils of the United States by means of aerial photography; and the Tennessee Valley Authority had developed a mapping capability for use in flood control and erosion. Private organizations such as the Eastman Kodak Company, Fairchild Aerial Surveys, Abrams Aerial Survey Corporation, American Paulin Systems, Park Aerial Surveys, Aero Service, and universities such as Chicago, Harvard, and Purdue loaned their talents and expertise.

On 5 January 1942, the Navy School of Photographic Interpretation opened its doors to a class of 26 Naval and Marine Corps officers. The eight-week course included the use of the stereoscope and technical aids to photo interpretation, including the determination of scale from aerial photography, plotting photographic sorties, the making of mosaics, map reading and map making, elementary principles of photogrammetry, and recognition of military and industrial installations, aircraft, shipping, camouflage activity, defenses, and electronics.

The Army established its school and the principal instructional tool was the 65-page TM-1-220, *The U.S. Army Manual on Aerial Photography*, which dealt primarily with cameras, scale, tone and texture, light and shadows, shape and size, configuration and pattern recognition, relief, stereo vision, mosaic and mosaic making, and the care and handling of material and equipment.

Interpretation and photogrammetric tools for all services could be carried in an attache case and consisted of a stereoscope, a tube magnifier with a reticule, soft pencils, scissors, a small knife, sandpaper (for mosaics), grease pencils, a compass, a pro-



FIG. 1. Founding fathers of the U.S. Naval Photographic Interpretation Center. Left to right: Capt. C. H. Cox, USMCR (now BRIGEN), LCDR R. S. Quackenbush, Jr., USN (now RADM, Ret.), and Capt. G. L. McCormick, USMCR (BRIGEN, Ret., deceased).

tractor, triangles, a T-square, dividers, a precision measuring scale, a slide rule, a magnifying glass, and a drafting set (Figure 2).

In the European Theater, Americans were integrated with British photographic interpretation units and quickly adopted the British methods of photo interpretation. The increased capabilities for acquiring aerial photography called for a commensurate increase in the qualitative and quantitative

interpretation of the photography. There was a frantic competition for trained interpreters and photogrammetrists among combat field commands, mapping and charting centers, and training commands.

There was an unprecedented demand for maps of many areas of the world that had never been mapped. In the Pacific Theater, there were frantic calls for maps of places like New Guinea, Guadal-

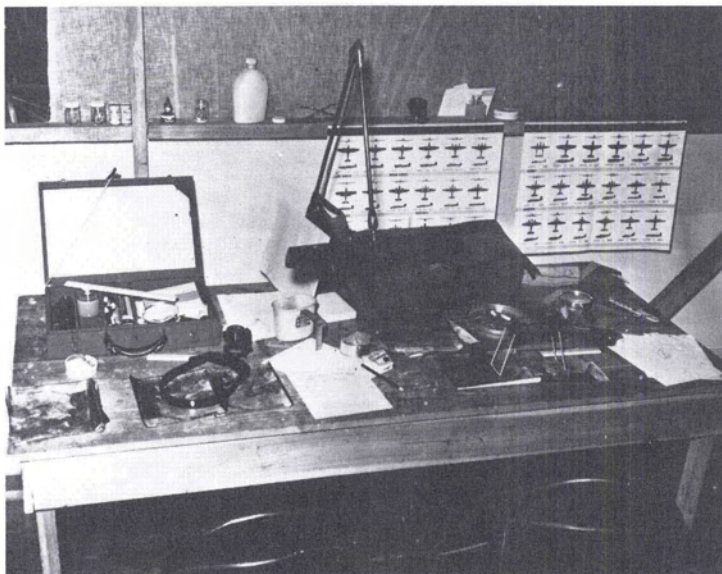


FIG. 2. Tools of the Photointerpreter and Photogrammetrist.

canal, and previously unheard-of-islands and atolls. Commanders in Europe demanded up-to-date maps and charts in support of the North African invasions of Morocco, Algeria, and Tunisia. The Army's entire map making capability was confined to a warehouse at Ft. McNair staffed by four officers and 100 civilians. By the time the war ended, more than 3,500 specialists were employed at a newly constructed facility at Brookmont, Maryland.

The United States had no photo intelligence capability in the Pacific at the outbreak of the war. Prosecution of the war in the Pacific presented entirely different circumstances than the war in Europe. The geography was different, the enemy's base of operations was beyond the range of most Allied aircraft, and there was little reliable information on the islands to be assaulted. The early Pacific operations were characterized by harsh experience, improvisation, consolidation of resources, and ad hoc personal initiative. For example, when photography of Guadalcanal was needed, the available Navy and Marine reconnaissance aircraft lacked sufficient range to accomplish the mission. Cameras were removed from Marine aircraft and installed in an Army Air Corps B-17 based at Port Moresby, New Guinea. The Navy performed the interpretation at Espiritu Santo Island in the New Hebrides Archipelago and created the mosaics and the 12-page sheet maps that were air dropped to Marine field units and served as the principal operating maps during the campaign. (Figures 3, 4, 5, and 6.)

Aircraft with increased speed, maneuverability, payload, and capability, were being added to the reconnaissance inventory throughout World War II. Concomittantly, improvements also were being made in aerial cameras; new developments included continuous strip cameras, the trimetrogon camera

system, night flash photography, and, later, radar-scope photography. The development of the trimetrogon camera system was a revolutionary achievement in aerial photographic mapping but also generated the need for highly specialized ancillary services, most notably those of the photogrammetrist. Early in the war, photogrammetrists had three distinct duties: (1) Preparing large scale maps from vertical photos, (2) preparing small scale maps from oblique and vertical photos, and (3) obtaining plan and elevation from oblique photos. There was also a need for specialized photogrammetric publications. To determine the height of objects from shadow length on aerial photos, the *Height Shadow Factors* manual was created. "Photogrammetric Tables for Intelligence Officers Employed in the Interpretation of Air Photos" was a compendium of tables to expedite photo interpretation and mensuration efforts. Research was conducted in the photogrammetric determination of speed and maneuvering ability of surface vessels from aerial photos. After the disastrous stranding of Marine Corps landing craft on the coral reefs at Tarawa, photogrammetrists were tasked to create methods for determining underwater depths from aerial photography. Photogrammetrists also played an integral part of the preparation of terrain and defense analysis models subsequently used by invasion planners.

Unprecedented progress in the knowledge and application of photo interpretation and the photo interpretation process was achieved during World War II. A 1943 publication mandated "A photo interpreter must have a knowledge of what he is looking for, its appearance, and how it works. He must know the enemy's country economically and physically, its industries, communications, terrain,

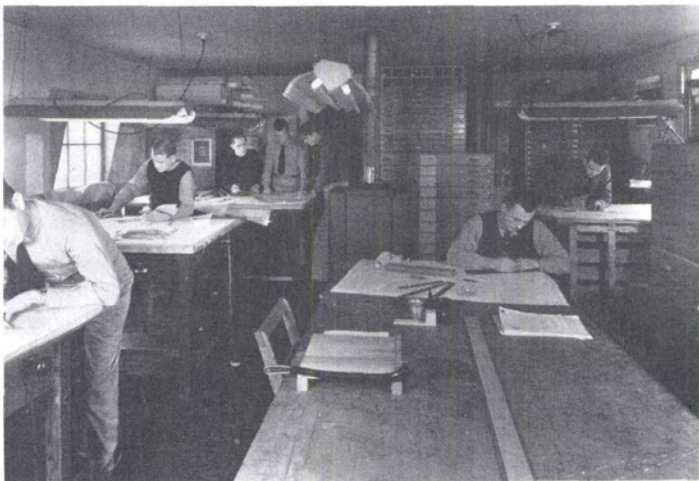


FIG. 3. Photo Interpretation Center, North Pacific, Adak, Alaska. In the center of the photo is Lt. Arthur C. Lundahl, who would later become the President of the American Society of Photogrammetry and the Director of the National Photographic Interpretation Center.



FIG. 4. Photo Interpretation Center, Forward Echelon, Guadalcanal.

etc. He is drilled in the characteristics and composition of various industries, airfields, railways and other inland transportation, warships, shipbuilding, general shipping, radio, camouflage, gun installations and armoured vehicles, bomb damage assessment, decoys and dummies. *He must be sure of what he reports.*"

Despite wide disparity of locations and objectives, photo interpretation organizations devised three separate reporting phases for the photo interpretation effort:

Flash or first phase: Photo interpreters at advanced bases or on carriers interpreted the reconnaissance photo immediately and flashed intelligence deemed vital or immediate that might affect tactical operations or combat.

Second phase: Photos were closely studied and more detailed reports issued. Data was charted and collected for additional combat operations. For plan-

ning invasions, the interpreters supplemented information on topography, prepared scale maps, contour maps, terrain models, and information on enemy defenses and activities.

Third phase: Detailed research was conducted on a large number of photos and a detailed report was prepared. These reports gave detailed as well as dated information on enemy installations and activities. These reports were also used in the education and training of photo interpreters in all the services.

During World War II, there was a paucity of basic geographical data about the European, Asian, and African landmasses. But no major military operation was under-taken without prior reconnaissance and photo interpretation efforts. In addition to photographing the battlefields, aerial surveys were made of the vast and worldwide logistical networks extending from Latin America to the Arctic and from the Himalayas to the Pacific Islands. For most of



FIG. 5. Photo Interpretation Center, aboard ship.



FIG. 6. Photo Interpretation Center, Esperito Santo, New Hebrides.

these areas, it was the first time they had been photographed from the air.

As the war progressed, it was obvious that intensified photogrammetric training was required. Photographic interpretation units in the field had increasing need for photogrammetrists for the preparation of specialized maps and terrain models. Interpreters attached to amphibious commands found photogrammetric experience essential because they were frequently called upon to make approach and fire support maps and charts. In response to these and many other needs, a ten-week course in photogrammetry was instituted at the Navy Photographic Interpretation Center in Anacostia in February 1944.

Perhaps the most significant contributions of photogrammetry to the war effort was the establishment of measurement or photogrammetry shops in the various Allied photo interpretation units. There was a need for precise measurements for a whole family of new strategic offensive and defensive weapons that were being developed, produced, and deployed. The most interesting photo interpretation and photogrammetric effort involved "Operation Crossbow," which traced the development of the German V-weapons program. Detailed analysis was performed on the Peenemunde complex of test stands, laboratories, liquid oxygen plants, supersonic wind tunnels, shops, and housing areas situated on a Baltic island off the German coast. Allied interpreters identified many of the rocket launch facilities as they were being built and they precisely measured and identified the missiles, rocket planes, and jet planes as they were being tested. Bombers were dispatched not only to destroy the research and developmental facilities but the deployed launch sites as well.

During the war, it is estimated that from 60 to 90 percent of Allied intelligence was derived from aerial photography of enemy held areas. Aerial photography and photo interpretation in many cases proved to be the only means of obtaining detailed, accurate, and timely intelligence of enemy strengths and capabilities. Bomb damage assessment (BDA) was accomplished almost exclusively by means of photo interpretation.

One of the largest photo interpretation efforts ever undertaken was the planning of "Operation Overlord," the Normandy landings of 6 June 1944. Patient experts poured over thousands of aerial photos for days pinpointing enemy beach defenses, troop dispositions, radar screens, supply dumps, airfields, and lines of communication and transportation. It was the interpreters who selected, analyzed, and constantly monitored the beaches and airborne landing areas to be assaulted by Allied Forces. More than 1,700 officers and enlisted men and women worked around the clock studying a daily take of over 85,000 negatives and prints. This task alone took more than a half million man hours.

The introduction of the B-29 photo reconnaissance aircraft extended our capability in the Pacific. In fact, Japan was completely mapped with aerial photography, and this photography was used to select targets for aerial bombardment, including the atomic bomb targets of Hiroshima and Nagasaki.

With the explosive growth of aerial reconnaissance, a steadily increasing number of photographic intelligence reports were being produced in all theaters of war. The diligent research, continuous study, constant self improvement, and experience gained allowed us to know much about the enemy's environment, lifestyle, customs, and military techniques. There was a proliferation of manuals pro-

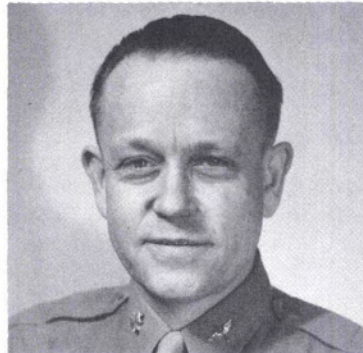
duced, and a need was recognized to consolidate this knowledge into photo interpretation keys. There also was a need to disseminate information on photo interpretation and photogrammetric procedures and techniques. The British published *Evidence in Camera* while the Americans published *Impact*. These two publications serve not only as a record of what was accomplished in World War II but chronicle the advancements made in reconnaissance, photo interpretation, and photogrammetry.

Since I opened this article with a German quotation, I think it's only proper that I close it with one. A captured German divisional order in 1944 stated: "Enemy aerial reconnaissance detects our every movement, every concentration, every weapon, and immediately after detection smashes every one of these objectives."

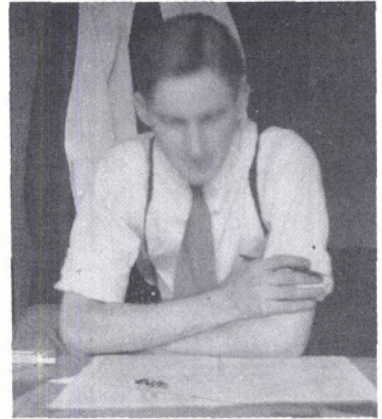
We came a long way in those three short years and set the stage for subsequent decades of achievement.



John M. Shields in 1934.



Riley J. Sipe in 1941.



Desi Eugene Slavoj just before he emigrated from Czechoslovakia after the communist takeover.



C. Eric Storms in November, 1934 in the Aero Service Corp. office and lab in Chattanooga, TN.



Francis E. Smiley, in the Summer of 1934 in Midwest, Wyoming.



Lawrence W. Swanson lived with his wife in Petrolia, CA, and was doing triangulation and topography with the Coast and Geodetic Survey in 1934.



Ernest R. Swanson in October, 1934.



Joe Theis. "When Sacred Heart College put on a play involving the devil, I was the obvious choice. They told me to just act natural."