

notary prepare the paper work necessary for a property transaction and make sure that the titles are in perfect order or otherwise, it is the surveyor who connects the descriptions in the Deeds with the actual physical location of the lot, so as to ensure that the property described on paper is the actual property existing upon the ground. Thus the peaceful occupation of the land by the owner depends a great deal upon the accuracy with which the lot has been marked out and this is the responsibility of the surveyor because he is the link between the document and the ground.

Gentlemen, it has been a great pleasure to address you today. I thank you for inviting me to come, also for your kind hospitality which my colleagues and myself have enjoyed very much.

Col. FitzGerald expressed the thanks of our Society to Mr. Lindsay. He commended the spirit of good will and cooperation which made it possible for Mr. Lindsay, Mr. Côté, Mr. Chipman, Mr. Siddall, Lt. Col. Andrews, Mr. Jackson and other Canadian members to attend the annual Meeting.

Col. FitzGerald then presented his paper on "German Photogrammetry in the War."

COL. FITZGERALD: In order to forestall almost certain, and probably justified, criticism that the following brief remarks do not cover fully the story of German photogrammetry in the war, I should like to state now, and with considerable emphasis, that no extensive research has been undertaken to amplify or verify the rather sketchy reports obtained personally from German technicians, both military and civilian, at the Hansa-Luftbild at the Templehoff in Berlin and various mapping organizations in or near Munich, during the past summer. In other words, to make a hard story soft, "While we do not guarantee this information, it was derived from sources we believe to be reliable."

Since I was principally concerned with the mapping operations of the German Air Forces, I did not attempt to obtain information regarding other military mapping operations which, if they were carried on at all by Germany during the war, were probably of minor importance.

Prior to 1934, a considerable number of private firms existed in Germany which engaged in aerial photography and photogrammetry. Many of these were small and specialized in vertical and oblique photography for industrial publicity. The larger and more important photogrammetric organizations were the Hansa-Luftbild GMBH in Berlin; Photogrammetrie GMBH in Munich; Aerokartographisches Institut in Breslau; and the Bildflug GMBH Bonn. These organizations were established following World War I and cooperated closely with scientists and inventors, as well as instrument manufacturers, in promoting the further development of photogrammetry. Practical experiments were encouraged and carried on, both in aerial photography and photogrammetry, and the results were subject to tests by precision methods, generally under the supervision of Government authorities. It is claimed that this cooperative experimental work resulted in a progressive reduction of costs, as well as a continual improvement in quality, especially in aerial photogrammetry.

Early in 1934, all existing private aerial photographic organizations in Germany, with their personnel and equipment, were combined to form the Deutsches Einheitsluftbildinstitut of the Hansa-Luftbild GMBH, with its main office in Berlin, and branch offices in Munich, Bonn, Munster and Breslau. The Breslau office was closed in 1936 and its personnel and equipment distributed among the other three offices. The Berlin office was assigned to work middle and eastern Germany; Bonn or Munster, northwestern Germany; and

Munich, southern Germany. In 1938, another office was opened in Vienna (Wien) for the Austrian territory then incorporated into the Reich. The Berlin office was responsible for all administration, as well as operations, while each of the branch offices was fully equipped to do the photography, and through modern photogrammetric methods, to complete the final map. Each office consisted of three main sections—Photography Aviation Section, Controlled Mosaic Section, and Stereosurvey Section. Equipment consisted of normal angle aerial cameras, 18×18 cm., and 30×30 cm., with focal lengths of 20 and 30 cm.; wide angle cameras, hand cameras for obliques, developing equipment, copying equipment, rectifying cameras, reproduction equipment, enlargers, stereoplanigraphs, multiplex and slotted templates.

The most important work of the Hansa-Luftbild was done for agencies responsible for land planning, road construction, river surveys, municipal buildings, flood control, irrigation, resettlement projects, reclamation, and forestry. Many of these organizations demanded large scale maps, 1:1,000, 1:2,500, 1:5,000, and 1:10,000. For general land planning 1:25,000 was used. Controlled mosaics on the larger scales were often preferred to topographic maps, partly because of the appreciable lower costs, and partly because they could be completed in much less time. Both planimetric and topographic maps were made of large areas, especially in northern Bavaria. For large scale work, horizontal and vertical control was established by terrestrial methods. For smaller scales and less exacting surveys, aero triangulation was accomplished with the stereoplanigraph, and in rare cases, with the multiplex.

One of the most important projects of the Hansa-Luftbild was the correction or revision of official maps such as the Deutsche Grundkarte 1:5,000 and the Topographische Karte, 1:25,000. Neither of these series was completed for coverage of Germany and photogrammetric methods were considered especially suited both to the original preparation of these sheets, as well as for revision. It was also proposed to complete a controlled mosaic atlas of all of Germany on these same scales. In carrying out the mosaic projects, great emphasis was placed on the quality of the photography and the accuracy of the final project.

Germany entered World War II with aerial photography and mapping operations of the GAF under an operations division of the General Staff. A Chief of Air Photography was the responsible head of this organization and was responsible mainly for the inspection of photographic and laboratory equipment and the development of aerial photographic organizations in the GAF. He was also responsible for the release of photography and the production, supply, and distribution of training and propaganda film.

In 1943 the office of the chief of aerial photography was greatly enlarged and reorganized as Department 7 of the General Staff. This new organization was given broad powers and charged with the responsibility for accomplishing most of the mapping photography for the GAF, for the preparation, reproduction and distribution of the photo-maps, special maps, and aeronautical charts required for training and operations in the GAF. To carry out this mission, Department 7 was divided into six main operating groups which were responsible for distribution, aeronautical charts and maps, library and source material, training, policy and specifications, and public relations.

The Hansa-Luftbild was militarized and redesignated Sonderluftbildabteilung and known as Sobia. The Director, Dr. Hans Gessner, was commissioned a Lt. Colonel and given the authority of a battalion commander. The branch offices were designated operation groups and continued to function in much the same way as in peacetime, only under direct military supervision. Although

Sobia was an external organization of Department 7, it continued throughout the war under full military control and was responsible for accomplishing photography, photogrammetric compilations, field surveys for control, the production of mosaics, anaglyphs and the research and development of all necessary equipment to carry out its mission.

Available information indicates that well over one and one-half million square miles were covered with mosaics at scales ranging from 1:1,000 to 1:100,000. Because of the speed with which military operations moved, photogrammetric mapping was accomplished for only the highest priority areas and in general at a scale of 1:25,000. This mapping was for the most part accomplished with stereoplanigraphs. The Hansa-Luftbild possessed five of these instruments in 1938 and was known to operate approximately twenty-five during the war. Numerous mechanical improvements were made on these instruments during the war, particularly modifications for using aerial negatives instead of reduced diapositives. It is believed that more than 100 of the stereoplanigraphs were manufactured in Germany mostly for sale and export to foreign countries.

The slotted templet method, originally developed in the United States, seemed to find great favor with German photogrammetrists. Several major improvements were made in this method which probably increased the accuracy for accomplishing graphic control.

Aerial photography to prescribed mapping specifications was obtained by the Luftwaffe for most of Europe. This was used principally for mosaics, the preparation of new maps by photographic methods and the photo checking and revision of existing maps. Many of these maps and photo-mosaics were recovered after the defeat of Germany, although most of the film was destroyed. A substantial part was burned in the bunker located under the Hansa-Luftbild building at the Templehoff in Berlin.

Both before and during the war, German officials, civilian and military, recognized the importance of research in photography and photogrammetry. Individuals and private companies were encouraged to conduct both research and development. Considerable work was accomplished in the design and improvement of aerial cameras for rapid reconnaissance mapping and long focal length cameras of special design for intelligence work. Camera stabilization through the use of gyro devices received considerable attention. Zeiss and other large companies in Germany continued development, with government encouragement, on stereoscopic plotting instruments and lenses.

The German Society of Photogrammetry which operated as a section of the International Society was the clearing house for the dissemination of information on photogrammetry and photography. Dr. Gessner, Director of the Hansa-Luftbild and later chief of Sobia, was president of the German society and maintained all records at the Berlin office of Sobia. Apparently the German section during the war absorbed most of the functions and responsibilities of the International Society. Records indicate that large meetings were held, principally in Berlin, during the war with approximately 1000 members of the society in attendance. General and technical papers were both discussed and those of particular note published by the Hansa-Luftbild. Records were found in Sobia in Berlin that indicated considerable interest on the part of Germans in American operations and development. Trimetrigon mapping for instance was discussed in detail and considerable work was done by German photogrammetrists in perfecting and improving the American slotted templet method.

There is no indication from records available that any new revolutionary photogrammetric processes or methods were discovered or perfected by German

technicians during the war. While sufficient equipment was available to do most of the required mapping, trained technicians were scarce and production was in general, slow. This is the principal reason why mosaics, and anaglyphs were often substituted for topographic maps for the carrying out of military operations. There is no evidence that German mapping organizations, in spite of a traditional background of research and development and the complicated instruments produced, has equaled our own country in the actual production of topographic maps through the utilization of modern photogrammetric methods.

Mr. Russell K. Bean was introduced. His paper, which follows, deals with the general aspects of German Photogrammetry and its development.

MR. BEAN: The information given is the result of investigations which were made in Europe shortly after VE Day. This mission was made possible through cooperation of the Geological Survey and the Corps of Engineers, U. S. Army.

#### *Terrestrial Photogrammetry*

Terrestrial Photogrammetry, the oldest branch of stereophotogrammetry, was revived during the war years and increasingly used in engineering projects, such as water and power supply, highways, and railroads. It was also used for military map revision in Alpine lands. A new small model of a terrestrial plotter—Klein Autograph—was ready to go into production at the war's end.

#### *Pleon Lens—136° and 148°*

Development of the 136°,  $f=8$  cm., Pleon lens was finished in 1936, but commercial use was barred by military authorities and research on proposed plotting equipment thereby hindered. The 148°,  $f=7$  cm., lens was developed during the first year of war to replace the German 9 lens camera, which also covered 148°. The very high marginal distortion of this lens is eliminated, to a certain degree, in an elaborate optical converter. Cameras of this type rendered very valuable results, according to reports, in reconnaissance mapping. It was used extensively over vast areas in Africa and Eastern Europe. Contact prints were reported to be useful as an aid to navigation by the Luftwaffe pilots. Both contact and converted prints were extensively used in radial line work, by the slotted template method.

#### *Use of Radar*

Apparently radar as an aid to navigation was not used on photographic missions; however, special instrumental methods of navigation were employed instead, in connection with gyro-equipment. Strips as long as 200 kms. were precisely flown quite straight and on parallel courses.

#### *Employment of Rectifiers*

Germany made extensive use of rectifiers, particularly during the war years. The large SEG-I type was used for both civil and military purposes. Controlled mosaics to accompany the 1:5,000 sheets of the German Base Map were made. Anaglyphic mosaics were made for military purposes at many scales and of different classes. Reconnaissance mosaics were quickly made, as substitutes for line maps of theaters of operation.

The small SEG-IV type was used more as a field instrument for both controlled and uncontrolled mosaics and for map revisions.

Attempts were to be made to improve the projection optics and the illumination of the rectifiers. The instrument was to be made more automatic, also.