

COLLABORATIVE MAPPING IN THE AMERICAS

THE INTER-AMERICAN GEODETIC SURVEY

The unprecedented demand for maps and charts, created by the postwar worldwide industrial and economic expansion, disclosed a startling lack of adequate map coverage of a great portion of the earth's surface, and emphasized the critical need for accurate geographical information. In 1945, recognizing the international aspects of a modern cartographic effort, the United States of America proposed the initiation of a comprehensive mapping program in friendly foreign areas throughout the world. The program for mapping Latin America, one of the most extensive collaborative mapping projects ever undertaken, is unique in that the conditions encountered, the methods employed, and the results obtained have no counterpart anywhere else in the world. The history of this undertaking is the story of the US Army Inter-American Geodetic Survey (IAGS).

Although many American nations had efficient mapping establishments prior to the inception of this program, no work was being accomplished on international or common hemispheric problems. To initiate a united, collaborative mapping effort, the United States offered diplomatic mapping and charting agreements to all the republics of Latin America, and in 1946, established IAGS as the principal working agency of the U.S. devoted exclusively to this program. Known throughout the Americas as *Servicio Geodesico Interamericano*, IAGS is a separate subordinate command of the U.S. Army Caribbean with headquarters centrally located at Fort Clayton, Panama Canal Zone. While IAGS is an Army organization administered by engineer officers, most of its technical personnel are civilians. Attached as supporting elements are the 937th Engineer Company (Aviation), who fly and maintain 26 fixed-wing and 16 rotary-wing aircraft in support of field operations; and the 551st Engineer Platoon (Survey), presently engaged in the accomplishment of supplemental mapping control and field classification surveys for mapping in the Republic of Panama and the Canal Zone. Now in its fifteenth year of operation, IAGS has an assigned strength of 75 officers, 9 warrant officers, 169 enlisted men, and 384 U. S. and national civilians.

From its Canal Zone headquarters, IAGS controls and supports field projects in 15 Latin American countries, covering an operational area of some eight million square miles and extending about 6 000 linear miles from its most northerly to southerly points. Field projects in each country normally consist of an officer in charge and an administrative warrant officer or NCO, a supply NCO, one to eight civilian cartographers (depending on the magnitude of the local program), an automotive mechanic, and

necessary supporting personnel. Additionally, on those projects where operations can be appreciably expedited by the utilization of airlift, pilots, mechanics, and aircraft of the 937th Engineer Company (Aviation) are assigned.

IAGS fulfills the commitments of the United States to provide material assistance to the collaborating nations by the loan of equipment, the furnishing of technical personnel in consulting and advisory capacities, the on-the-job training of national personnel, and the actual accomplishment of those cartographic operations which are beyond the current capabilities of the nations concerned. To further assist the participating governments in advancing their geodetic and cartographic capabilities, IAGS in 1952 established a cartographic school in the Canal Zone which, through bilingual instructors, provides specialist-type training in the basic subjects of astronomy, triangulation, geodetic leveling, field surveying, photogrammetry, computing, compilation, drafting, and scribing.

The main goals of this gigantic program are to obtain aerial-mapping photography and all geodetic data necessary to produce topographic maps and hydrographic and aeronautical charts; to establish a strong geodetic connection between the North and South American continents; assist the collaborating countries to increase their geodetic and cartographic capabilities; and to foster, throughout the Americas, standardization of mapping equipment and procedures.

These objectives primarily call for the establishment of a geodetic-control system to provide the foundation for all future surveys and mapping of Latin America. The completed network will require the determination of the position and elevation of each of many thousands of points on the ground through the establishment of 91 000 miles of primary-triangulation arcs and more than 100 000 miles of primary level lines. This program includes the observation of some 350 astronomic stations, measurement of 250 baselines, installation and observation of 100 tide gauges, and the establishment of over 27 000 geophysical stations to determine magnetic declinations and gravimetric variations.

The determination of the position of the triangulation stations is accomplished, first, by selecting an origin to which all other points are referenced, and determining its geographic position with respect to the *true* equator and the zero meridian which passes through the astronomic observatory in Greenwich, England. Secondly, the points are referenced to the origin by the measurement of distances and directions. Thirdly, the entire framework is adjusted to conform to the configuration of the earth by using all available data including precise observations of the stars.

Elevations are established by precise leveling over permanent benchmarks throughout the Americas. The marks are spaced about two kilometres apart along national and transcontinental highways, railroads, and trails. More than 70 000 permanent benchmarks have been established. The vast network of closed loops and circuits to tide-gauging stations extends from the boundary between the United States and Mexico to the Panama Canal, and from Colombia to Chile and Brazil. In a few years the gap from Panama to Colombia will be closed and will complete a continuous line of leveling from Alaska to southern Chile. Elevations are adjusted to mean sea level

as determined at primary tide stations. In this manner all elevations, whether for use in geodesy, cartography, geophysics, highway and railroad construction, hydroelectric development, or other economic and scientific enterprises, are all referred to the same datum.

The preliminary horizontal-control datum for South America, called the Provisional South American Datum of 1956, has been established at La Canoa in the eastern part of Venezuela. A gravity-datum project, accomplished by Venezuela with the assistance of IAGS, included the determination of the horizontal position and elevation of about 1 700 points within a radius of 150 kilometres of the origin. Gravity observations were made at each of these stations through the use of Worden gravimeters. This datum has now been connected to the North American Datum through two first-order triangulation networks; one running through Central America and Mexico to the Texas border; the other through the islands of the Antilles to Florida. Application of this datum to the participating South American countries will be made through adjustment of all intermediate points within a geodetic loop extending down the Pacific coast, across Bolivia and Brazil, and following the Atlantic coast back to La Canoa. At present this loop is complete with the exception of a 1 700-mile gap from La Canoa to Campo Maior, in northeastern Brazil. A United States Air Force aerial-survey team is presently working to close this gap by means of an airborne electronic (HIRAN) survey.

With a large portion of the scheduled basic geodetic control now completed, increased emphasis is being placed on obtaining high-altitude aerial photography, and in accomplishing supplemental mapping control in those areas where such photography, suitable for stereocompilation methods, is available. Most of this photography has been or is being flown by the U. S. Air Force and by commercial firms through contracts let by the U. S. Army Map Service, although several countries have contracted for their own photography. IAGS has also loaned cameras and furnished film to some of the collaborating agencies to assist in obtaining coverage of gaps in existing photography and coverage of unphotographed areas for which immediate map compilation is desired.

Where adequate photo coverage is available, a determination of the requirements for lower-order ground control is made. This control includes the determination of the position of the preselected horizontal-control points and the establishment of elevations for vertical-control points. The number of control points is determined by the quality of the photo coverage, photogrammetric instruments to be used, and the scale of the map. In establishing ground control for the compilation of maps, the classification of cultural detail is normally obtained as part of the ground-control program.

In summation, one of the most important aspects of this program is the providing of training. The International Cooperation Administration recognizes the importance of maps in planning its programs, and has made provisions for a coordinated training program in geodesy, cartography, and geophysics. Under this program, three agencies — the United States Coast and Geodetic Survey, the United States Geological Survey, and the Inter-American Geodetic Survey — provide training to personnel of the participat-

ing countries. The resources of these agencies assure a complete coverage in all phases of cartographic training.

It can truly be stated that this program is one of the outstanding examples of international collaboration. It has resulted in the efficient and economical utilization of engineering capabilities of each country concerned, and, as maps are the basic prerequisite of all engineering and development projects, will greatly increase the development of natural resources and provide greater opportunity for friendly and economic relations.