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THE INTER AMERICAN GEODETIC SURVEY
TWENTY-FIVE YEARS OF COOPERATION

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United States objectives in Latin America have been frustrated by mismanagement and misunderstanding in spite of continued application of U.S. resources. In contrast the Inter American Geodetic Survey has made solid progress toward engineering achievement and hemispheric solidarity since 1946. Official and technical documents are reviewed for keys to the concept of operation, and the organizational arrangements that have permitted this progress to continue in an uncertain international climate. Technical accomplishments are reviewed briefly. Adaptation to individual country requirements within an overall program, realistic long range goals, continuity of management, and emphasis on development of Latin American capabilities are singled out as major elements in IAGS performance, and are suggested for application to parallel programs.

THE INTER AMERICAN GEODETIC SURVEY - 25 YEARS OF COOPERATION

Over many decades of association the United States has experimented with ways to work with Latin American nations for mutual progress. Countless formal organizations exist, from the Organization of American States to unheralded specialized forums. In addition the United States has pronounced and implemented major policy directions, as The Good Neighbor Policy, and The Alliance for Progress. If the history of these relationships has not demonstrated failure, it has rarely produced success. More typical is compromise and disappointment, because of mixed motives and a general lack of performance. As the Rockefeller Report of 1969 summed up: "The United States has allowed the special relationship it has historically maintained with the other nations of the Western Hemisphere to deteriorate badly."¹ The causes have been narrow special interests, other priorities, fiscal constraints, a bureaucratic tangle, and unrealistic rhetoric. The report goes on to say that assistance policies have been distorted to serve a variety of United States purposes, often in sharp conflict with the goals of development. "The United States has talked about partnership but has not practiced it."²

¹Nelson A. Rockefeller, et al., The Rockefeller Report on the Americas (1969), p. 21.

²Ibid.

Within this dismal atmosphere are found occasional examples of success that can show solid progress toward goals, and enthusiastic support by the very Latins who usually are critical. One of these examples is the Inter American Geodetic Survey (IAGS). Such an institution is a candidate for examination as a model for progress in this difficult hemisphere.

THE CONCEPT OF IAGS

At the close of World War II the War Department set about to rectify the wartime shortage of mapping that had impaired military operations in many parts of the world. In Latin America the response was the organization, in April 1946, by the Caribbean Defense Command, of the Inter American Geodetic Survey. IAGS has not only outlasted its parent, but has flourished and maintained its organizational integrity under several other headquarters.³ It is now an element of the Defense Mapping Agency.

In essence the goal of IAGS for a quarter of a century has been to execute mapping, charting, and geodetic (MC&G) programs in Latin America of significance to the United States Department of Defense.⁴ But Latin America is an area of over ten million square miles, largely undeveloped, including vast tracts of some of the

³Ecuador, Instituto Geographico Militar (IGM), Twenty Years of Mapping in the Americas, (1966), p. 11.

⁴United States Southern Command (USSOUTHCOM), Mapping and Charting Program, Progress Report FY 70 and Operations Plan FY 71, (FOUO), p. 6.

most inhospitable land on earth. Extremes of climate and topography are well represented and broadly distributed. In 1946 the infant Survey assayed the task and readily concluded that meaningful survey would take many years, and would require vastly more resources than available to a small U.S. organization. Thus the concept of operation has provided since 1946 that U.S. efforts are primarily directed toward acquiring and evaluating source data, and providing management and technical advice to cooperating agencies. These agencies, elements of various participating governments provide the majority of personnel and facilities to carry out the technical programs.⁵ Unfortunately in 1946 many of the cooperative agencies themselves existed in a rudimentary state and the first task of IAGS was to create viable partners.

The double requirement to produce geographic information, and to develop the several agencies that would do most of the work, has led to a cooperative program of immense value. In particular it is a program in which the interests of the United States and those of the various Latin countries coincide, setting it apart from less successful programs. As a matter of fact the mission of IAGS was originally defined in terms of assistance to collaborating governments, recognizing in 1946 that direct contribution to the United States lay in the future. Elements of the original mission statement were: "assistance and guidance in the accomplishment of a

⁵Ibid, p. 7.

program of geodetic control and map production"; promotion of "the use of standard equipment and techniques ... ; ... training supervision and guidance ... in order that all of these (collaborating) agencies may become cartographically self sufficient"; and "(creation of) good will and hemispheric solidarity."⁶ This early mission requirement has led to the fulfillment of the long range goal of execution of significant MC&G programs.

SITUATION BEFORE 1946

In 1946 geodesy and cartography in Latin America was represented by fragmented and uneven progress. There were a few geodetic baselines in Peru, for example, measured in the 1920's, whose first order accuracy was proven when they were remeasured in 1954.⁷ Brazil had commenced precise triangulation on a limited scale near Porto Alegre in 1904, but had not begun to use accepted first order specifications until 1945.⁸ Venezuela had accomplished very little precise triangulation.⁹ Examination of other countries records shows similar sketchy progress. Of equal significance was the lack of a common datum, common methods and standards, and any geodetic

⁶Inter American Geodetic Survey (IAGS), The Status of MAPPLAN 1946 - 1954, (FOUO), (March 1955), p. 5.

⁷Merrill Brown, Norman E. Fassett, and Joseph A. Kozlosky, Mapping and Geodesy Goals in Latin America, (1967), p. 1.

⁸IAGS, *ibid*, p. 291.

⁹*Ibid*, p. 328.

tie between the few sets of geodetic control that existed.¹⁰

Thus the value of all the work was at best purely local.

In the field of cartography, Mexico, Ecuador, and Chile had produced some large scale maps based on outmoded planetable and stadia methods.¹¹ In Brazil, the agencies of various states had produced partial mapping coverage at 1:100,000.¹² But Latin American mapping had primarily been at small scale (1:1,000,000 or smaller), necessarily based only on the limited geodetic control described above. Some countries had planned extensive mapping projects, as did Peru in 1922, only to see little or no progress because of lack of funds, training, and equipment.¹³ The best pre 1946 map of Nicaragua was published by the U.S. Marine Corps at 1:150,000, and based on an assortment of military, public works, and private sources of varying quality.¹⁴

Contrasting with the poor state of Latin mapping and geodesy in 1946, an organizational framework had existed for many years with the potential to meet the requirements of the region. Almost every Latin nation had some form of geodetic organization in being. Some of these had been long established to execute comprehensive programs, those in Argentina and Chile dating from the 19th century.

¹⁰Merrill R. Brown, et al., *ibid*, p. 2.

¹¹Ecuador (IGM), *ibid*, pp. 55 and 79.

¹²IAGS, *ibid*, p. 288.

¹³Ecuador (IGM), *ibid*, p. 117

¹⁴IAGS, *ibid*, p. 123

Many were autonomous military units, or were part of the Army staff; and others had their origins as boundary commissions to seek solutions to some of the perennial disputes over borders. Only Nicaragua and Panama had to establish completely new organizations to work with IAGS when it was formed.¹⁵

To complement the efforts of these national units, the Organization of American States created the Pan American Institute of Geography and History (PAIGH) in 1928. The Institute is composed of three commissions on cartography, geography and history which meet about every two years.¹⁶ PAIGH has subscribed to and set certain cartographic standards, but there is little evidence that it took any positive steps to advance the practice of cartography. Rather it has been characterized as a "forum of discussion",¹⁷ and such an Institute does not produce maps.

One other source of geodetic data existed in the files of various private corporations, primarily oil and mining companies who had performed geodetic work as a basis for exploitation of mineral resources. In most cases these were made available for government use but in at least one case, in Colombia, data of one company could not be made available to a competitor, and thus had to be restricted from public or general use.¹⁸

¹⁵IAGS Fact Sheet, IAGS/DOD Mapping and Geodesy Program, Argentina, (1971).

¹⁶"Geography, Societies of", Encyclopaedia Britannica, Vol 10, p. 152.

¹⁷G. P. Woolard, Director, Hawaii Institute of Geophysics, letter to Honorable Patsy T. Mink, 26 August 1970.

¹⁸IAGS, The Status of MAPPLAN 1946 - 1954, (FOUO), March 1955, p. 195, p. 340.

The general result of such a general disarray of mapping and geodetic data was that any large development project was constrained by lack of comprehensive surveys and maps, or acquired the added expense of its own geodetic work. In the atmosphere of Latin America before World War II this was just one more reason why little development of economic value could be done.

The lack of maps in a remote area has prolonged a particular political and boundary problem between Ecuador and Peru. The two have disputed their border since their political split in 1831. One hundred ten years of rancor climaxed in a Peruvian military victory over Ecuador in 1942. In the Protocol of Rio De Janeiro that followed, the United States, Argentina, Brazil, and Chile settled the dispute by guaranteeing a new boundary defined by certain landmarks. A considerable length of the specified boundary followed the watershed between the Zamora and Santiago Rivers. Aerial survey completed in 1946 revealed another river, the Cenepa, between the two named, and thus, two separate watersheds. Ecuador immediately seized upon the ambiguity and later used it as a pretext to denounce the Protocol. She thus renewed an old problem that should have been laid to rest. Imperfect and incomplete geographical knowledge in 1942 was thus a major contributor to the political failure.¹⁹

¹⁹David H. Zook, Jr., Zarumella-Maranon: The Ecuador-Peru Dispute, (1964), p. 205 ff.

ORGANIZATION OF IAGS

Against this background of vast geographical ignorance, the founders of IAGS in 1946 had to devise a plan that would, in a reasonable time and at reasonable cost, bring results, in the form of maps, surveys, and other hard and useful information. The approach was to use and expand upon what existed in order to make use of its latent potential. To that end IAGS wrote a standard mapping agreement, bilateral in form, designed to be executed between the United States and each Latin country and (in 1946) each colonial power. The standard agreement stated that the United States desired to accomplish aerial photography and geodetic survey necessary to compile large scale (nominally 1:50,000) maps of the Republic in question. It pointed out existing inadequacy, and assumed certain obligations of the United States, which promised to: execute required aerial photography; provide expert personnel to examine existing control and determine and plan further requirements; provide survey personnel when the local government could not; and furnish the local government copies of all photography, surveys, and maps produced.

At the same time the local government promised to: permit the taking of aerial photography and the free entry of U.S. personnel, provide country representatives; provide all existing MC&G data to the U.S.; provide technical field units as available, and to permit free use of facilities. It was further agreed that all work was

solely for the mutual benefit of the U.S. and the cooperating government; that information derived would not be revealed to a third nation; and that original data would be retained by the U.S.²⁰

Within two years agreements, modified in detail to suit particular requirements, had been signed between the United States and sixteen Latin countries, as well as Great Britain and France (representing certain colonies).²¹ Mexico signed an agreement later in 1953, and Paraguay in 1962.²² Only Argentina, Uruguay, and Surinam have declined agreements, but even these nations participate with IAGS in various joint projects.²³ Of the original agreements only that with Cuba has lapsed,²⁴ in spite of diplomatic problems between the United States and Latin countries, especially those on the west coast of South America.

Upon conclusion of each agreement, IAGS set up a project office in the participating country. Each project (country) director was a U.S. Army officer, and in a typical case, he has been assisted by an NCO and a small civilian staff, professional and administrative.²⁵ For many years U.S. Army light aviation supported the field work.²⁶ Over the years the strength of the

²⁰IAGS, *ibid*, p. 5.

²¹IAGS, *ibid*, p. 7.

²²Ecuador (IGM), *ibid*, p. 102, p. 114.

²³USSOUTHCOM, *ibid*, p. D-4-1, p. D-17-1, p. D-18-1.

²⁴Ecuador (IGM), *ibid*, p. 71

²⁵IAGS, *Organization and Functions Manual*, (1970), p. 13.02.

²⁶Ecuador (IGM), *ibid*, p. 29.

various projects has ranged from two to thirty depending on a country's requirements and its own resources.²⁷ From the beginning a major task of the project director has been to develop a cartographic agency in the country, and to cause the country to increase its mapping budget by increasing understanding of benefits of an adequate MC&G program. Concurrently he determined country requirements and directed IAGS efforts.²⁸ An IAGS headquarters, professionally staffed, directed the efforts of the project offices toward coordinated effort, meaningful programming, and optimum use of resources.

IAGS experienced a developmental phase until the early 1950's, when progress toward all goals was slow, and Latin governments could not accumulate the wherewithal to help themselves. At first some local survey was performed by IAGS crews because of the extreme shortage of local technicians. At the same time IAGS parties made the principal geodetic connections through Central America and parts of South America. When the last IAGS field parties phased out around 1955, one of their principal accomplishments had been to provide on-the-job training for over 1,300 Latin Americans.²⁹

²⁷IBID, p. 43 ff.

²⁸IAGS, The Status of MAPPLAN 1946 - 1954, (FOUO), (March 1955), p. 8.

²⁹Merrill R. Brown, et al., *ibid*, p. 3.

KEYS TO PROGRESS

Two particular events caused the Survey to break away from its early slow pace, and the programs have been moving well ever since. They were, the founding of the IAGS Cartographic School in 1952, and the commencement of a considerable program of large scale mapping photography by the U.S. Air Force in 1954. These have provided the means and the incentive for enthusiastic Latin American participation.

Early IAGS operations showed clearly the lack of skilled technicians needed for achievement of IAGS goals. An early training camp filled initial requirements, but most of the trainees were from the United States. The long range answer has been the IAGS Cartographic School. Established at Fort Clayton, Canal Zone, in 1952, it began at once to offer practical, short term, technical training, in Spanish, in all of the basic geodetic and cartographic skills.³⁰ Over the years the school curriculum has increased in scope and sophistication to match that of the Latin mapping agencies. In 1965, for example, a college level course in advanced photogrammetry was introduced.³¹ Some of the recent professional courses are six months or a year in duration, but most of the courses are still sixteen weeks in length.

³⁰IAGS, *ibid*, p. 410.

³¹Ecuador (IGM), *ibid*, p. 26.

The school was not slow in producing trainees, and by June 1954, 139 Latin Americans from seventeen countries had graduated.³² By 1970 there were 2,635 Latin American graduates (as well as 255 U.S. military and civilian), and enrollment continues at over 200 per year. Cost of training was originally borne by the Point IV program (later USAID). The Military Assistance Program later sponsored many students, but increasingly, non U.S. funding has been used. In FY 71, 46 percent of the students were financed by Latin American sources.³³

Clearly the steady production of technicians has been basic to the steady improvement in Latin American mapping agencies, and the fulfillment of their programs. The courses, in Spanish, in Panama, are within reach of countless Latins of limited education. Unlike many students who study in the United States at considerable expense, and then never go home, all IAGS graduates are immediately available to put their knowledge to work where it is needed.

In concluding the series of bilateral mapping agreements in the late 1940's, the United States had promised extensive aerial photography, but this was slow to materialize. In 1954 IAGS reported that "Failure of the U.S. to provide the promised aerial photography necessary for map production has resulted in a reluctance of some collaborating governments to expend further funds, either for securing additional geodetic control, or

³²JAGS, *ibid*, p. 412.

³³USSOUTHCOM, *ibid*, Annex E.

purchasing equipment for which there can be little foreseeable use in the immediate future."³⁴ Fortunately, the solution to this problem, which would require several years, had begun. In 1954 the United States and the collaborating countries embarked on a program to cover large portions of Latin America with high altitude vertical aerial photography. Participants were the U.S. Air Force, and commercial firms under contract to the U.S. and Latin American governments. By 1967 aerial photography suitable for accurate standard large scale maps had been accomplished over 2,850,000 square miles in the region.³⁵ Photography continues, with an increasing demand for larger scale photographs of areas of dense population or high economic potential.

As the basic elements of a comprehensive geodetic and mapping program became available, cooperating governments were encouraged to active participation with their own resources. By the mid 1950's, basic geodetic control, aerial photography, and trained native technicians brought life to agencies that had been dormant, and basic map data were produced, to be converted to finished maps by the U.S. Army Map Service, or the countries themselves. Between 1955 and 1967, 2,100 large scale sheets were prepared, and a production capacity of 400 new sheets per year had been achieved.³⁶

³⁴IAGS, *ibid*, p. 15.

³⁵Merrill R. Brown, et al., p. 6.

³⁶*Ibid*, p. 16.

Progress was particularly rapid in Central America, where El Salvador and Costa Rica led the way in carrying out modern large scale mapping program. Both nations are completely covered at 1:50,000 scale, IAGS support requirements have diminished, and the national mapping agencies have been able to devote their resources to cadastral work and very large scale development maps. Guatemalan mapping is scheduled for completion in FY 74, and the neighboring countries are not far behind.

In South America progress is somewhat less rapid, but most of the remote and unpopulated interior is not programmed for mapping in the immediate future. Brazil is making excellent progress in its more important regions, and publishes new mapping at the rate of about 80,000 square miles per year. Bolivia published its first map sheet in 1963, and large scale coverage now exists over 23 percent of the country. These figures are typical of the accomplishments to date in South America, where sheer country size poses a quantitative problem not found in Central America. In each country the indigenous mapping agency is moving forward with a program of large scale mapping.³⁷

³⁷IAGS Fact Sheets, IAGS/DOD Mapping and Geodesy Program (1971-72) for Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Paraguay, and Peru.

Numerous other aspects of geodetic work have been addressed over the years by IAGS and the collaborating governments. Geodetic control, horizontal and vertical, basic to engineering planning as well as mapping, was the first IAGS activity, and it continues. As extensive systems of tide gages refine the datum for vertical control. Measurements of gravity have been extensive and are used toward an increasingly accurate geoidal model. Magnetic observations lead to data on anomalies and annual change. Special mapping such as air navigation charts and city plans is accomplished. The overall program has been a comprehensive one, leading to the collection and publication of a full range of data.³⁸

LATIN AMERICAN MAPPING AGENCIES

It is in the development of indigenous mapping agencies that the IAGS accomplishment is most impressive. Each participating country has one or more organizations that are charged with particular aspects of geodetic activity. With a very few exceptions, each country has the personnel and equipment to perform any geodetic or cartographic task, from establishment of precise geodetic control, through extension of control by aerotriangulation, to map compilation and reproduction. The work of these agencies is generally good and often excellent. Deficiencies are mostly quantitative rather than qualitative.³⁹ In order to meet

³⁸USSOUTHCOM, *ibid*, Annex D; and Merrill R. Brown, et al., *ibid*, p. 7 ff.

³⁹Merrill R. Brown, et al., *ibid*, p. 16-17.

quantitative programmed goals the United States still participates as needed. IAGS continues to provide training, aerial photo support, and technical assistance to field crews. The Defense Mapping Agency Topographic Center performs data reduction and compiles and prints some of the map sheets.⁴⁰ Meanwhile, native production has added several thousand map sheets to the U.S. DoD inventory. Most important, in almost every case the native government has gained enough confidence in the capability and usefulness of its own geodetic agencies to spend scarce capital on buildings, technical equipment, and salaries to further the work. In the context of Latin American fiscal insufficiency, this is a measure of success. Through the years of building these agencies, IAGS has acted as a catalyst, applying generally limited resources to break bottlenecks in field operations, training, and equipment procurement.

When in 1970 the United States announced plans to curtail and ultimately discontinue the Inter American Geodetic Survey, Latin American countries immediately asked for reconsideration, and produced widespread testimony of the value of the Survey. President Jose Figueres of Costa Rica expressed to President Nixon his "concern over the proposed phase down of one of the most successful programs of the United States Government in Latin America, namely the U.S. Army's Inter American Geodetic Survey." He stated that "I believe I speak for all Central America in saying we definitely need this type of cooperation."⁴¹ Similar letters

⁴⁰USSOUTHCOM, *ibid*, p. 7.

⁴¹Jose Figueres, President of Costa Rica, letter to President Richard M. Nixon, 27 August 1970.

were received from officials of PAIGH, and from the various national geographic institutes, and from scientists in the academic community.

ESSENTIALS OF IAGS EXPERIENCE

After more than twenty five years service to the United States and the Latin American nations, IAGS continues to achieve meaningful cooperation and accomplishment, even while other better financed programs have seen growth and decline. It is useful to summarize, for broader application, the elements of the IAGS experience that have been a key to success. The Survey is based on a series of bilateral agreements for mutual benefit, standard in format, but recognizing individual country requirements. IAGS operations have been keyed to realistic achievable phased objectives within long range programs. U.S. participation has been deliberate and constant, but always pointed toward Latin participation, development, and accomplishment. U.S. resources have been made available to start a geodetic program, and to break obstacles in its path, but not to complete it. The latter has been left to the rapidly developing counterparts. Happily the IAGS name and organization has remained intact since 1946, and not subjected to revision with new administrations or commanders. This continuity of clear cooperative purpose has elicited the Latin American response so necessary to the IAGS concept of operation.


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