A PHOTOGRAMMETRIC MAPPING PROGRAM FOR LATIN AMERICA*

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RECENTLY many articles have been published concerning the future development of Central and South America. The direction which this development will take has become increasingly important to the United States. In fact, it is of the utmost importance that our ideas of culture, business and government honesty should play the major part in this development, rather than that of the European systems of dictatorship and barter trading.

The Government of the United States has recognized the seriousness of this situation and already has taken steps along certain lines to insure our participation as a major factor in this development. As is well known, our Government's actions include reciprocal trade agreements, closer cultural relations by exchange of professors and students, and other co-operative measures for unity and defense against foreign aggression.

However, it appears that our Government's program does not include one very important matter. Immediate steps should be taken to obtain a more accurate knowledge of the basic conditions which control the proper development of the natural resources of those countries.

The need for such information in the development of rubber producing lands within our defense area is only one of the more important and immediate demands. There are literally hundreds of other industries which are looking for information on the natural resources of those countries in order that they will not have to depend on sources of supply which, in the future, may be in hostile hands.

The engineer will realize that these natural resources cannot be developed successfully without adequate knowledge of the topographic conditions. Such knowledge is required before definite plans can be made for their proper development.

A greater portion of the Western Hemisphere, south of Mexico is, to all practical purposes, unmapped. Great areas are practically unknown and the knowledge of other large areas is, at best, only fragmentary. To be sure, maps exist of all those countries, but these maps are not trustworthy and can hardly be used as a base for actual planning. It is only in isolated small areas that one can find adequate topographic information in map form.

In order that these countries may become economically strong and bear their fair share of the responsibility for the defense of the Western Hemisphere, the United States should aid them in obtaining a more accurate knowledge of these topographic conditions.

Photogrammetry will play the major role in obtaining and portraying this needed information in map form. It is inconceivable that this information can be obtained as easily and as quickly by older methods of land surveying or by any means which omits topographic mapping.

The job of mapping the different countries of Central and South America is a tremendous one. The urgency of making adequate progress in the more important areas of every one of these countries cannot be satisfied by ordinary commercial methods of procedure. By this, it is meant that the job cannot be done by aerial photographic companies from the States, operating as they do with infrequent contracts from local governments, or from oil and mining companies.

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Usually such surveys are not made to commonly accepted standards, as the specifications for each contract differ from others in accordance with varying local conditions and needs. If the problem of mapping Latin America were left to such commercial contracts, the result in years to come would be a conglomeration of different scales, varying control and accuracy.

It is obvious that the Government of the United States cannot conduct such extensive surveying operations, even if consent were obtained from the various local governments, since our own demands for better maps here in the States have not been satisfied.

There is, however, a practical method of approach to the problem—that of encouragement and aid to each of the Latin American governments in establishing their own photogrammetric survey departments, with a co-ordination of standards and accuracy.

One or two of the South American countries already have organized departments for this purpose. They have purchased from European sources a considerable amount of equipment, including cameras, stereoscopic machines, laboratory equipment and surveying instruments. Considerable time has been spent in training personnel, which has been done under the supervision of European technicians. It is sincerely hoped that real progress in mapping will soon be made in these countries.

One way that the United States can materially aid the other Latin American countries in such a program is in photogrammetric training for their engineers. Such training should include both technical instruction in our universities which teach this subject and also practical training with our commercial photographic companies or with one of the branches of our Government which work in this field.

One is apt to suggest that the Latin American engineer could obtain sufficient training from commercial surveys that are made from time to time in various parts of South America. There are several reasons why such training cannot be accomplished on ordinary commercial jobs.

1. Commercial contracts are written for stated sums and usually have to be completed within certain time limits. The contractor is working under uncertain conditions and is far from his home base. His prices must be high to protect him from uncertain conditions and accidents. The square unit cost for these surveys will be much higher than for similar work in the States. High prices lead to few contracts, since most Latin American countries have other uses for their limited funds. Therefore, the majority of these surveys will be made for oil and mining companies.
2. Due to the above conditions, the contractor cannot give time for the proper training of local engineers. All experienced personnel must be imported from the States and the local engineer does not enter the picture except in a minor capacity, with no chance of learning any of the important steps in making maps from aerial photographs.
3. Another handicap is the language. Although a number of Latin American engineers speak and read English with more or less perfection, yet they naturally prefer Spanish, especially when receiving instructions in a new technical subject. The photogrammetric experts from the States, even if they had the time and willingness, would find it difficult to give instructions to the majority of these engineers who are not proficient in English.

The writer has had some personal contact with one North American Company which has successfully performed aerial surveys in Central and South America. Some of these contracts only covered a limited amount of ground

control, the flying and delivery of a control plot and contact prints. The actual construction of the maps was performed by oil geologists.

While the writer is not familiar with all the details of these contracts, yet he believes that the maps resulting from these surveys will not be available for public distribution, since they contain geologic information of a private nature to the oil company.

In observing the field operations of this company on its first Central American contract, it was noted that all technical employees were brought from the States. Although the company's plant was open to reasonable inspection, yet it is safe to say that the local engineers were unable to gain any useful knowledge of photogrammetry on this job.

One does not criticize the operations of this company, since it was bound to a certain amount of secrecy by the oil company. However, the conditions under which this work was done illustrates the fact that contracts of this nature do not offer opportunity for the local engineer to learn even the rudiments of the work.

It can be assumed that most of the commercial surveys that may be performed in the future in these countries will be conducted under more or less similar circumstances, whether they are made for oil or mining companies, or for other concerns interested in the economic development of any given region. Contracts with local governments would probably be conducted with less secrecy, but still under the handicap of prices and time limits.

This statement is not intended to condemn commercial work of this character. Every reasonably accurate map, even of small areas, adds valuable information to the little we already have. However, to depend entirely on commercial contracts, either for the mapping of Latin America or for the education of their engineers in photogrammetry, only retards the development of those countries.

The need, therefore, seems to be for direct instruction of Latin American engineers in order that programs of mapping, which have some standards in common, can be started simultaneously in all of these countries.

Such a program of training could be started in several ways.

1. Courses in photogrammetry should be started in as many Latin American universities as possible. Our present program of exchange professorships should include photogrammetry.
2. Undergraduate students should be given scholarships in our universities which teach this art. This too is in line with the present program of our Government.

However, the writer does not think that this approach to the problem is all that should be done. There seems to be a need to train, and to train as quickly as possible, a large number of graduate engineers, photographers and pilots in the practical side of mapping with aerial photographs. Such training can only be obtained by participation in actual mapping operations. This will mean one of three courses, and better still, a combination of the three.

1. Commercial photographic companies operating in Latin America should be willing to employ and train a large number of local engineers and photographers. Contracts with local governments will probably specify such arrangements, since many other commercial enterprises are now required to make similar arrangements. Contracts with oil and mining companies should include such arrangements. It would be to the ultimate advantage of the photographic companies to have employees in key positions who understand local conditions, including those of a political nature as well as the economic and field conditions.

2. Arrangements should be made with photographic companies operating here in the States to accept and train graduate Latin American engineers and photographers for a suitable length of time. This procedure, if financed solely by these companies, would be impossible in these times, due to the condition of their business. However, it is possible for our Government or for some private educational organization to finance this phase of the program.
3. Since there are only a limited number of commercial companies which are equipped to give thorough and practical training in the many phases of the art, our Government should accept as many of these engineers as possible for training in the different Federal departments where aerial photographic mapping is performed.

The surveying operations to be conducted by the individual Governments under this program probably would be somewhat similar to our own Federal mapping program, in that efforts would be directed toward producing maps of smaller scales for general study and use. Naturally geodetic surveys and other basic operations in map production would be included in the program. It is not proposed to "shut out" commercial mapping contracts in Central and South America. In the Governmental programs, as in our own country, it is likely that some Governments would desire to contract the photographic flying. Oil, mining and other special purpose surveys on the larger scales probably will still be performed by contract and the North American aerial photographic companies should be able to obtain their share of this work.

In order that a fuller discussion of these proposals can be made, the writer would like to enlarge somewhat on the bare outlines which have been given above.

In putting this program into effect, our Government should move with care. The program should not be lumped together with the existing cultural program. To realize this one must consider the various phases of the program which deals not only with technical advice to the Latin American governments and their universities, but also with our commercial companies and with various departments of our Government. Also, it should be handled by men who have had adequate training in photogrammetry and who have some knowledge of the Latin American temperament.

Such a program should receive the active backing of the American Society of Photogrammetry and the commercial photographic companies. It is hoped that outstanding members of the Society and the commercial interests would be selected as consultants to the office or commission intrusted with this program.

There are far too few of our universities that appreciate the importance of photogrammetry to engineering. The art, as a commercial success, has been developing for over 20 years and most engineers who have had contact with its growth appreciate its real value to many lines of engineering. More universities should organize courses in this subject, especially State universities, where the cost of providing proper equipment could be borne by direct appropriations from the several States.

Present indications are that it will be difficult to obtain many professors who have adequate knowledge of the art. This deficiency possibly could be overcome by selection of outstanding photogrammetric experts from our governmental departments.

The undergraduate student, after completing the course in one of our universities, should be given a period of practical training in one of the commercial

companies, or in one of the Federal departments. After such a training period, he would be in a position to contribute his full share to the progress of the program in his own country. Today, too many college graduates in this and other professions are not fitted for immediate commercial work. The problem of obtaining further topographic knowledge of the Latin American countries is urgent and immediate progress is necessary.

It will be noted that the proposed program is divided into two phases, university instruction and practical training.

It should be apparent that to depend entirely on the university phase would mean that little, if any, progress could be made for a period of from 4 to 6 years. Most of this time would be consumed in organizing and in the education of the first allotment of students. The quicker way to obtain immediate progress and to give adequate technical support to the future of the program is to combine both phases.

It is proposed that the period of practical training to be given both the student and the graduate engineer should be between 6 months and 1 year. Both the Federal departments and the commercial companies should be authorized to determine the individual progress of each trainee and to terminate the training period when sufficient progress has been made.

Piloting on a photographic mission for mapping purposes is an art in itself. Few commercial pilots can fly such missions successfully without considerable previous training. It would seem advisable to include some pilot training in the program.

Some will say that giving a graduate engineer a training period as suggested would not make him a photogrammetrist. It is granted that he may be weak in some of the theory and mathematics of the science. However, if the engineer is selected for his intelligence and willingness to learn, there is no reason why he cannot become proficient in mapping with aerial photographs.

The writer has observed a practical demonstration of the results of such training. As Chief of the Demarcation Commission of the boundary between Guatemala and Honduras from 1933 to 1938, and as member of the Mixed Boundary Commission concerned with the selection and demarcation of the line between Guatemala and El Salvador from 1934 to 1938, he has been in close contact with a large number of Latin American engineers.

The work of these two commissions was varied, consisting of first order geodetic and astronomic control, stadia transit traverse of the boundary line, construction of concrete boundary monuments, identification and surveys to locate photographic control points for the plotting of the maps, compiling planimetric maps from 4 lens aerial photographs, least square adjustment of the first order control nets and other local surveys for preparing charts and reports to the local governments.

All of the local engineers appointed to these commissions had a sound basic engineering education, some having graduated from colleges in the States, while others were graduated from their own universities. It should be mentioned that engineering practice, as taught in some Latin American universities, differs somewhat from methods used in the States, since these courses are based on European practice.

Notwithstanding previous training, all of these engineers willingly co-operated in adopting a common standard of instrument practice and note-keeping.

While the majority of these engineers were employed in the field, yet all had some contact with the photogrammetric side of the work, and all were very much interested in it. Those engineers who participated in the map compilations be-

came expert workmen. They would make satisfactory employees for any commercial company and are capable of directing an aerial survey in their own country.

In conclusion, it seems safe to state that the work of these boundary commissions indicated that the Latin American engineer can be quickly trained to do practical work in aerial photographic mapping. With selected personnel and careful supervision of training, it is believed that a program of mapping could be started in several Latin American countries within a period of two years.

The combination of exchange professorship and under-graduate student education with the practical training of the graduate engineer would insure immediate progress with a future based on sound technical training. In time the program would operate to shift full responsibility of training to the Latin American universities.

The immediate and most urgent phase of the program should be stressed again and again. The defense, both military and economic, of the Western Hemisphere requires the full development of all the resources of the Latin American Republics. Every move that is made in this direction should be based on sound knowledge, especially topographic knowledge, of these countries. The writer urges the co-operation of the Society towards this end.