SOMETHING ABOUT NORTH AMERICAN PHOTOGRAMMETRY BY A SOUTH AMERICAN*

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I AM A photogrammetrist by conviction, vocation, and "perspiration." More than 20 years working with plates, films, photogrammetric cameras, rectifiers, restitution machines,—and what is very important—photogrammetrists have definitely forced me into bearing this "hell on earth." Disillusionments and joys of different kinds, and some good friends who are not afraid of the same destiny are the balance of this long "pleasure."

Of course, this "sin" cannot be compared with any other and, because we know that it is not shared by too great a number of colleagues, we are trying to convince more to join us; but lamentably we of the "first hour" are too widely spread over the world to be able to unite our efforts with sufficient intensity.

In 1937, I had the exceptional privilege of doing something with respect to this, during my trip of study to Europe where I met Poivilliers, von Gruber, Hughershoff, and Berchtold. After the hard interval imposed by the war, I became acquainted with Nistri and Santoni. Afterwards, during the Chartographic Conference in Buenos Aires (November 1948), I contacted almost all of them again, as well as Schermerhorn.

But due to different causes beyond my control, I did not get the opportunity of communicating with the best photogrammetrists of the great nation of the North to the extent I should have liked. In 1946, but with some difficulty, I exchanged a few letters with Prof. E. Church, and in 1947 I had the pleasure of contacting Mr. and Mrs. Abrams here in Buenos Aires. In 1948, when the above mentioned Chartographic Conference took place in Buenos Aires, I at last had the opportunity of meeting, even though only briefly, some of the well known photogrammetrists of the United States, of whom I had read so much in the old pages of PHOTOGRAMMETRIC ENGINEERING, familiar to me since the first copies —type Rotaprint—in 1936.

But this first meeting with my North American colleagues was unexpectedly repeated at the beginning of 1949, when I had to go for the first time to the United States on private business. The memory of that wonderful, although only short trip, is always present in my mind. The fine reception I had from Messrs. Reading, FitzGerald, Adams, Medina, Kelsh, Bean, Tewinkel, Sharp, Whitmore and others left a deep impression on me, and herewith I beg to assure them of my gratitude.

In return for such kindness I think it only right that I frankly give my impressions of what I heard and saw there. I hope that, together with those of other photogrammetrists, they will contribute, although only on a small scale, to the evolution of the technique that is the main object of our life.

I must first express my great astonishment at the enormous production of maps and plans made aerophotogrammetrically in the United States. The surface covered by these aerial surveys is really extraordinary; visitors will see without effort that aerophotogrammetry is well known and intensively used by the government as well as by private companies.

I express my admiration for this great work but I cannot help confessing, in a friendly manner and with all respect, that I was completely disconcerted be-

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cause nearly all this work is done with old fashioned methods and using on a large scale instruments of anaglyphic projection and the more simple ones of stereoscopic observation (stereocomparagraphs, K.E.K. plotters, etc.), the technical and economical efficiency of which cannot be high. I believe that the results obtained have no relation to the large sums which probably were invested for this purpose.

I thoroughly understand that what I said above requires a full explanation, but doing this would require many more words than I can devote to this brief summary of the impressions I gained from my trip. Nevertheless, I do not want my colleagues of the North to think that I commit the irreverence of expressing my points of view without taking the trouble of explaining, although only briefly, the thoughts which led me to this opinion.

Above all, it is beyond my comprehension why mass production of aerophotogrammetric maps is executed with hundreds of "Multiplex" projectors. This instrument, notwithstanding its attractive presentation and fascinating operation, is one of those of lowest economic efficiency; this is well known. While many people will not share this opinion, I believe a few figures will convince even the most skeptical.

Actually, it is very easy to prove that the mean errors of the coordinates of any point of an aerophotogrammetric survey, made with a certain aerial camera, are given by the following simple expressions $m_x = KD = m_y$; $m_z = K'D$, in which K and K' are precision coefficients and D the denominator of the scale of the photograph used in the plotting instrument. Therefore, if instead of using the original photograph in a plotting instrument of the so-called universal types (Stereotopograph, Autograph, Stereoplanigraph), it is used in a Multiplex, its scale must be reduced in the approximate ratio of 1:4; for this simple reason the precision which can be obtained is automatically divided by four. But to this must be added that the relation between the precision coefficients K and K' of a universal apparatus and the K_1 and K_1' corresponding to a *very well adjusted and corrected* Multiplex is 1:3 on the average; therefore the results obtained by a Multiplex are nearly 12 times poorer than those obtained from a good universal instrument. Thus, if the reduced positives of 54×54 mm., which are placed in the Multiplex, have a scale of 1:50,000, it is immediately understood that, by all means, it is much more convenient to use an original photograph of the same scale in a universal apparatus, because the surface ratio will be 1:16 and the precision obtained will be increased from 1:3. Also it will not be at all necessary to print the small diapositive or to reduce afterwards the restituted map as in the Multiplex; thereby two important sources of expense and errors are eliminated.

As the relation of working cost between a Multiplex and a universal instrument is far from being 1:16, and because a flight at twenty thousand feet height is cheaper than one at five thousand feet, I trust you will understand my astonishment at the quantity of maps produced by using the Multiplex.

In confirming this thesis, I think it convenient to point out that European countries, with less economical possibilities than the United States, are doing without anaglyphic projection machines and instead are using big high precision restitution machines almost exclusively.

In addition I wish to say a few words about another matter which also left me perplexed: I was told that the company which produces maps by the Brock process has done and is still doing an excellent business. It seemed impossible to me that such a complicated system, integrated by primitive methods, would be apt for commercial exploitation; I thought that nowadays nobody would risk

working like this. For this reason I very much regret that I did not have sufficient time to go to Philadelphia for the purpose of directly studying the method of profitably making aerophotogrammetric maps using a process which must have complicated peculiarities, low precision and high cost. Therefore I could not see why there was not added to the Brock's Stereometer, the elemental and most simple mechanical devices that would enable it to produce directly the wholly correct orthographic projection of the planimetry and of the contour lines, without using the tracing instrument, the results of which are partially affected by error.

But in contrast with the preceding, I also knew that some time ago the interest in the big restitution instruments of high precision has notably increased. Besides, I observed in a Division of the Department of the Interior two or three very new Autographs Wild A5 and one or two Stereoplanigraphs Zeiss, brought over from Europe after the War. I also was informed that there was an ardent desire to use Poivillier's machine and to try the Stereocartograph from Santoni. In our far away Argentina, the Autograph Wild has rendered excellent and economic service (A2 since 1935, A5 since 1938, and A6 since 1940), as well as the Stereoplanigraph from Zeiss (since 1938); also since 1938, the limited efficiency of the Multiplex has been confirmed—at present the instrument is not in use. These make me often wonder about what caused the strange evolution of photogrammetry in such a country as the United States, the essential characteristics of which are the marvellous advance of technique and the rational evolution of its processes.

Will I be too bold if I explain here my viewpoint on this subject? I will try it trusting that whether right or wrong it will meet at least the benevolent curiosity of my friends of the North.

Without doubt the most simple instruments for observation and measurement were much used in the United States since the first beginnings of aerophotography. The radial-plotters and contour finders were the forerunners of those which are now called radial planimetric plotters, mechanical triangulators (lazy-daisies), slotted-templates, stereocomparagraphs, multiscopes, K.E.K. plotters, etc., etc., all of which have contributed largely to popularize the methods of elaboration of aerophotographic maps and which can be purchased by the great majority of professionals, due to their low cost.

Also without doubt the United States has also lived for a long time without having a complete knowledge of the marvellous evolution of European photogrammetry. This can be noticed throughout the pages of PHOTOGRAMMETRIC ENGINEERING including its latest copies (Vol. 15, Nos. 1, 2, and 3) but especially in Mr. O. S. Reading's article entitled "Photogrammetry in 1936," which was published in Vol. 2, No. 2, and which begins with these erroneous words: "Photogrammetry in 1936 resembles the automobile industry in 1910 or the radio in 1920." I cannot accept this comparison; in Europe in 1930, several of the excellent aerophotogrammetric lenses and cameras were already in use and were also being manufactured in 1945; also prior to 1936, the principal instruments for restitution (Stereoautograph and Stereoplanigraph Zeiss, Stereotopograph Poivilliers, Autograph A2 and A5 Wild, Photochartograph Nistri and Photostereograph Santoni) were well developed and improved, and in addition several methods for aerolevelling, aeropolygonation, and aerotriangulation had been thoroughly studied and published by eminent photogrammetrists since 1925 and 1935.

But Mr. Reading in this article said something of exceptional importance with regards to the matter I am discussing. "These machines (for automatically tracing the map) cost from thirty to seventy thousand dollars and therefore a

large capital outlay is required . . . In the past two years the Zeiss Company has developed a Multiplex projector which costs *only* about seven thousand dollars delivered in this country . . . This machine *does satisfactory work* on contour intervals of ten feet or more." (I have *italicized* the words I consider especially illustrative.)

Without doubt, the few quoted lines of Mr. Reading's article give a clear idea, not of "Photogrammetry in 1936" but, "The Start of Photogrammetry in the United States in 1936."

I also think that the above mentioned "which cost only seven thousand dollars" gives the clue to the persistent discussion on Economics in Photogrammetry started some time ago. I refer to the articles of Messrs. L. T. Eliel, A. Hill, R. L. Moore, and R. S. Pearse published in *Proceedings of the American Society of Civil Engineers* (Vol. 71, Nos. 3 and 6—1945) as well as to the latest publications in PHOTOGRAMMETRIC ENGINEERING entitled "Operation and Comparison of the Stereoplanigraph" by C. M. Cottrell (Vol. 15, No. 1), "Effects on Map Production of Distortions in Photogrammetric Systems" by J. V. Sharp and H. H. Hayes (Vol. 15, No. 1), and "Increased Accuracy of the Multiplex System" by J. V. Sharp (Vol. 15, No. 3), and in addition even the propaganda of some companies such as the one which refers to the marvellous skill of one of its engineers who in other times could measure 925(!!) shots of planetable per working day of 8 hours, and at present is an excellent operator of one of the most modern restitution machines.

Mr. Sharp's writings in particular show the inefficiency of the Multiplex, although its followers and designers are persistently trying to improve it, in order to obtain more efficiency than that secured to date and which, lamentably, I believe will never be acquired.

During my short stay in Rochester N. Y., I was very well received by the Bausch & Lomb Company, where I personally contacted Mr. Sharp. He was most kind and it was my great pleasure to talk with him extensively, trying to explain the reasons for being convinced of the Multiplex's anti-economy, and the impossibility of obtaining an acceptable precision. I also suggested to him the convenience of at least omitting the reduction of the original photograph, using for this purpose a small aerial camera with plates of $5\frac{1}{2} \times 5\frac{1}{2}$ cm and with which the cost and errors of this process would be considerably reduced. I think that he listened with interest but without believing too much.

It does not matter; time will be the surest and most implacable of judges and some day we shall see who is right.

In my opinion, photogrammetry in the United States got through an evolution of harmful "countersense." In this country of great enterprises and initiative, there was a fear of investing large sums in the installation of instruments, which with great economy fully solve all the problems of elaboration of topographic maps. The reason is probably a lack of precise knowledge of what was happening on the other side of the Atlantic Ocean. At present, photogrammetry is going on there between a close net of simple instruments which will surprise everyone who goes there as I did in order to learn something new and to see a wide photogrammetric horizon.

But the new tendency is going on, and I am absolutely sure that due to the leaning towards the instruments of high quality, the United States within a very short time will have recovered from the losses and difficulties. Such is my ardent wish.

I wish to express my most heart-felt sympathy with my kind colleagues of the Republic of the North and I assure them that I shall never forget the cordial welcome during my stay in the United States.