VARIOUS VIEWPOINTS

Professor Schermerhorn: Former President, International Society of Photogrammetry

I HAVE only a few remarks to make after what my young friend Corten has told you about the results of the Paris conference. I hope to publish in the issue after the coming one of *Photogrammetria* the complete text of the American proposal, and the results of the Paris conference, perhaps with some discussion of the comments made today.

There is always a certain confusion about this calibration problem caused by the fact that there are two different approaches—one from the man who has to use the instrument, and the other from the man who has to make the instrument. My successor at Delft University, *Dr. Roelofs*, attempts in our next issue of *Photogrammetria* to break through this difficulty by putting the problem as simply as possible from the point of view of the user of the instrument, throwing out of the window all that came from the side of the manufacturers.

I fully agree with the explanation that *Dr. Pestrecov* has given about these problems and difficulties. The real purpose of the user who wants calibration may be to obtain reproduction of the bundle of rays in the object space at the moment of exposure. There is a problem of intersection, just as the subject of photogrammetry itself is a problem of intersection, in so far as it involves geometry. You deal with this as a problem of intersection and find automatically a certain center of perspective. What it is physically or geometrically doesn't mean anything. However, if you take this point and if you have the corresponding point in the negative ready, you do not have to worry about all these other things. That is the meaning of this publication of Roelofs.

The same is true with the problem of the point of symmetry. We all know it is caused by eccentricities of the lens system. It is not our problem, but that of the factory. We have to find, if possible, one point in such a way that, by using this point in the reconstruction of the picture, we can get results that satisfy the man who wants to make a map. It is a point that gives the maximum accuracy that can be obtained.

Roelofs has set forth an easy possibility to do just that. If the problem of calibration is a problem of intersection in space, as he says, you can get the same linear equations if you use only the first order terms, but take care that all the points are used. Then you come back to the same linear equations that you can get also with the graphical solution of the equations for the intersection in space, as used by the orientations of *Poivilliers*. It gives you the same graphical method for an easy solution to find this point of symmetry. You can call it the point of symmetry as he does but that is not necessary. It is the only point that counts for you. You have to put this point that you find there in the restitution instrument, in the fiducial center of your restitution apparatus. That is all that is necessary. No further knowledge about the whole thing is required.

If there is any suspicion that there is something wrong with it, then you write to the factory and say, "What you have sent me seems to be not too good. Please take it back and improve it and I will check it again until I am satisfied." That is the manufacturer's problem and that is what they are paid for—and not too badly.

Now I come to the field of resolution. We want to compare cameras of different systems. We want to have certain possibilities of comparison. That is what we are trying to get, standardization of these methods. You must never forget that it is not forbidden to apply any other method that is not standardized. That is what we stressed in the Paris conference. Do not give too much emphasis

to definitions about what has to be done. Leave people free to do what they want to do, on one condition, that they indicate exactly what they have done, exactly the accuracy of their own measurements. That is important.

You get many nice distortion curves without the slightest idea about the precision of the method used for getting these curves. You can draw a nice curve through all these points and it seems to be not too bad.

In this case you perhaps also have to rely on the factory's figures. I have no objection to that procedure, but I ask that they give us the specifications. I am just as willing to accept the specifications of a factory as those of a scientific institution, on the condition, however, that they give the accuracy of the method and indicate it on a certificate the same way as we ask of others.

I hope you will give your attention to this publication by Roelofs. I have here a few reprints of that article from *Photogrammetria*, and I will give these to those who are interested. (I do this on one condition, that you do not thereby avoid a subscription to *Photogrammetria*. That is not the reason for distributing this.) I believe the article has a certain value—as a method. Also it gives the most complete information on this subject, all the existing literature from the early beginnings, from the 19th century to 1950.

As to the problem of the point of symmetry, we have two methods. *Mrs. Schule* is using two points, to the left and to the right. That takes care of terms of the second order. That is one method. *Roelofs* takes care of only the terms of the first order, but on the other side he is using all the points that have been used for the calibration. That is the difference between these two methods. I believe Roelofs' method is the less difficult because of the easier adjustment in accordance with the theory of least squares.

In the European proposals that Mr. Corten has announced, there are a few of the smaller items where we in Delft are not completely in accord, although we were more or less overrun in Paris. Three days is a long time, but if you must come to a definite statement, there is a shortage of time.

On the French side, there was proposed in Paris that we use the definition "principal object ray of auto-collimation." We might call it the "principal point of auto-collimation." That is the point of intersection of the ray perpendicular to the plane of the negative in object space. We are not very happy with this long expression. We are quite sure that the result will be that everybody will use the words "principal point" and leave out the matter of auto-collimation.

Then you have the famous confusion again with the expression "principal point" in the old meaning. In accordance with what Mr. Corten has said, it is a most dangerous procedure to give a new meaning to old words.

Also, where these old expressions are not very exact, you must be extra careful with the new expression. To correct this old expression is bad, for this reason: From our side, we proposed to use other expressions and we proposed that we talk about central point, central object ray and central image ray. We proposed the use of the word "central" instead of "principal." We proposed that we keep "principal" in the old meaning of the expression, and if we want an expression for this other use, we should use the word "central." Then the central point has the other meaning of the point of intersection of this perpendicular ray. Then, in doing the measurement by auto-collimation, you find this point automatically.

I hope to present a discussion of this question in the next issue of *Photogrammetria*, in which we will deal with this problem.

Another problem, not fully stressed by Corten, is the problem that on the continent of Europe the great majority are using the visual methods. They have been treated very inadequately in these Paris proposals. We propose to add

certain items to these proposals especially for the application of the visual methods.

Chairman Howlett: As the last item on the agenda, we will allow the "highly paid" manufacturers to say something on their behalf through their representative. I have great pleasure in calling on Mr. Revere G. Sanders, Assistant Vice-President, Fairchild Camera and Instrument Corporation.

A CAMERA MANUFACTURER'S COMMENT ON CAMERA CALIBRATION

Revere G. Sanders, Ass't Vice-President, Fairchild Camera and Instrument Corporation

I SHOULD like to start by defining calibration. My associate did, but I have a definition which I think is a lot better. It is "a lot of hard work involving an expense for the manufacturer, which he can hardly expect to recover, couched in terms few people can understand or agree upon."

There are two very good reasons why a manufacturer should not get involved in this calibration. First, I refer to expense. For getting the equipment and preparing for building our calibration outfit I believe we have spent about $40,000. And that is only the beginning.

You not only have to put in the equipment but you have to operate it. You cannot take any liberties with accuracy. Also you cannot compromise on techniques. So you must get fully qualified people, and that results in high running expense.

You should realize that of all the cameras made in this world, only one tiny fraction is used to make maps, and those are the ones for which you use this elaborate calibration equipment.

REVERE G. SANDERS

I like to use simply the expression of furnishing a topographic mapping certificate instead of the word "calibrate," and give the data which support that certificate. As regards the term "calibration" we note that many of the specifications of the government services, which specify that certain calibration shall be done, provide for a report by the Bureau of Standards and that this report is simply headed "A Report of the Bureau of Standards on Lens No. So-and-So." I do not think they call it calibration. The people who are using the cameras, writing the specifications or talking about calibration, are the ones who are supposed to provide the calibration and they are a little careful in discussing it. If we call it a topographic-mapping camera certificate, you have what you are talking about.

Of course, if it is such a terrible thing for a manufacturer to shoulder the burden of expense on a limited number of cameras, why does he get into it? There are some very good reasons. That is what caused us to take the deep