INSTRUMENT METHOD VERSUS CONTACT METHOD OF FLYING FOR AERIAL SURVEYS

George J. De Garmo, Jr.,
President, Standard Aerial Surveys, Inc.

WHEN two mapping pilots get together and start discussing the best method of flying aerial surveys you will hear two different opinions, from three mapping pilots you will get three opinions, etc., and yet there is probably no type of commercial flying so specialized and requiring greater skill than the flying necessary for aerial mapping. Within the knowledge of the writer, there have been, to date, no instructions written on this subject and no regularly-established commercial courses of training in this work.

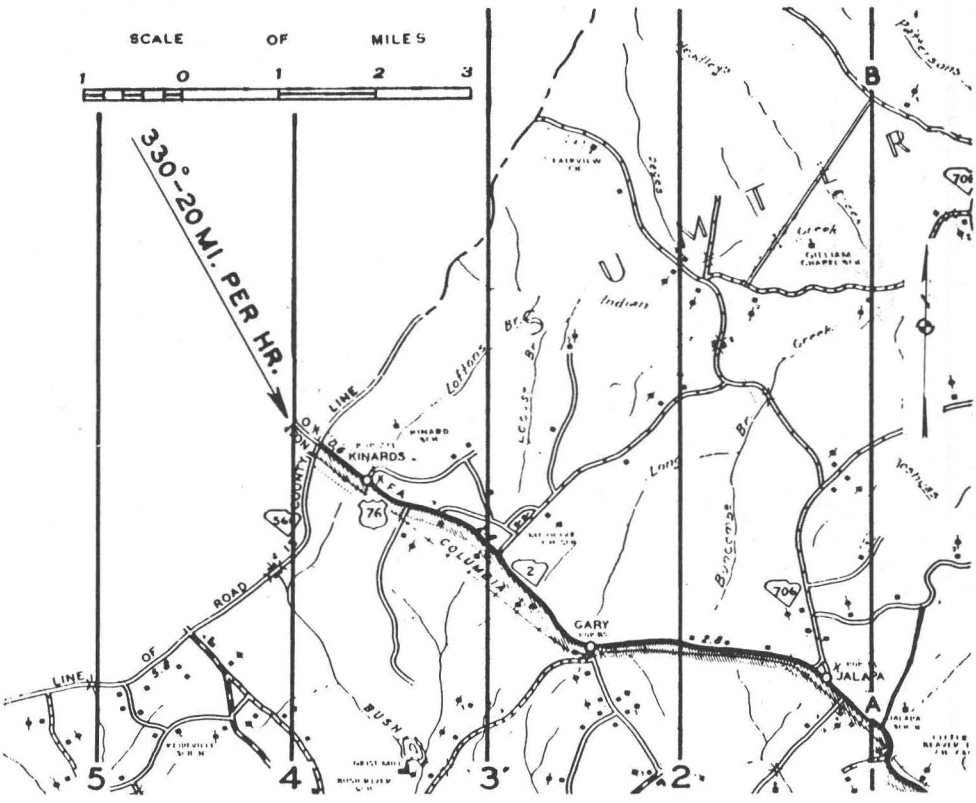

FIG. 1. Flight Map Copy.

With the specifications for aerial photography as promulgated by the various departments of the United States Government becoming more and more rigid and the competitive situation becoming keener, the subject of the best method of flying aerial photographs becomes increasingly important. It is obvious that poor flying or poor team-work between pilot and photographer can seriously curtail the progress of the mapping operations.

To get back to the difference in opinions among pilots as to the best practice it boils down to some adaptation of either of two methods which we might call the "Contact Method" and the "Instrument Method."

Before we go into the advantages and disadvantages of these methods let us study the problems in flying several photographic strips over country where there are no section lines. In sectionized country there is very little difficulty, since, with a glass window below him, the pilot can very easily follow the section lines, almost as easily in fact as following a road. In many parts of the United States, however, there are no section lines and the problem becomes more complex.

Referring to Figure 1 we see three strips spaced approximately two miles apart and about ten miles in length. We note that the strips are to be flown North-South in direction and that the wind is from 330°. In the Contact Method the pilot would estimate his drift by one or more trial or "dry" runs and would then be ready to start. Crabbing his plane into the wind (toward his left if

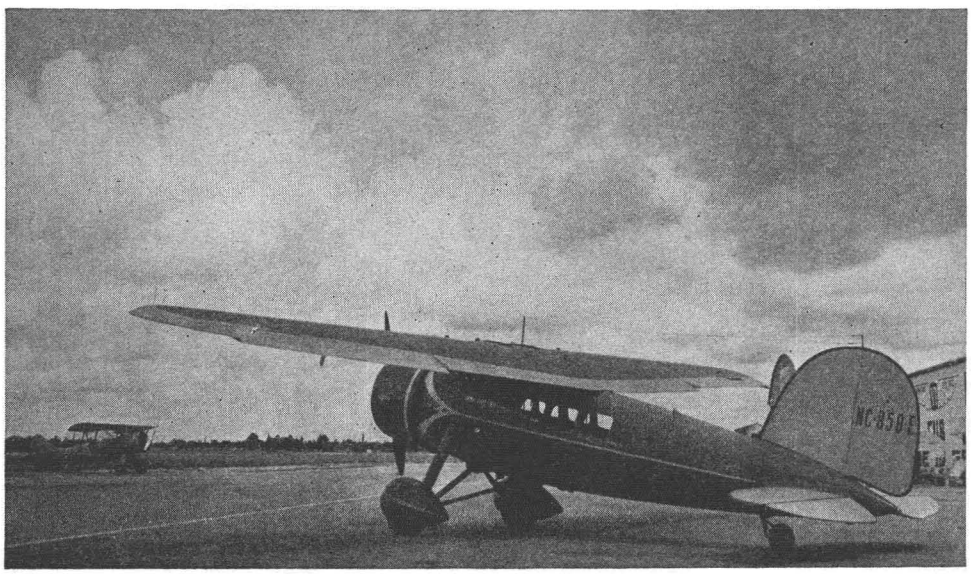

FIG. 2. Lockheed Vega Mapping Plane Used in Instrument Method of Photography.

heading north) he could see down his line especially if he shifted to the right seat of the plane. If he were a contact pilot he could estimate that he was the proper distance from road intersection "A." He could also pick two or more points ahead and line them up with some projection in or on the plane, thus maintaining a straight course until point B was close enough to determine whether the plane would pass the proper distance to the west of it. If not, he would make a slight correction and acceptable mapping would result. On the second strip (#2) which is to be flown South, the crab would be to the right and the pilot would shift to the left seat and repeat the process. The entire success of this type of mapping depends on the natural or acquired ability of some pilots to fly a straight line, and to estimate their exact position and relation to some point such as "A." This skill unfortunately, is not too common since, even with a glass window under the pilot's feet it is very difficult for the average man to tell just what point he is directly over. The angle in the setting of the glass, and, making observations from various side and backward angles, tend to introduce large errors in judgment. Then, in looking ahead when there is a decided crab and being able to tell that you will pass directly over some point such as "G,"

is a matter of expert judgment. Unfortunately, there are too few pilots who can do a consistently acceptable job of contact survey flying.

It is doubtful if a good contact pilot can impart his method or system to a student mapping pilot. It seems that a natural skill is a prerequisite or else you never make a good contact mapping pilot and continued practice seems to help you very little. The writer is speaking from long experience and personal contact with many mapping pilots.

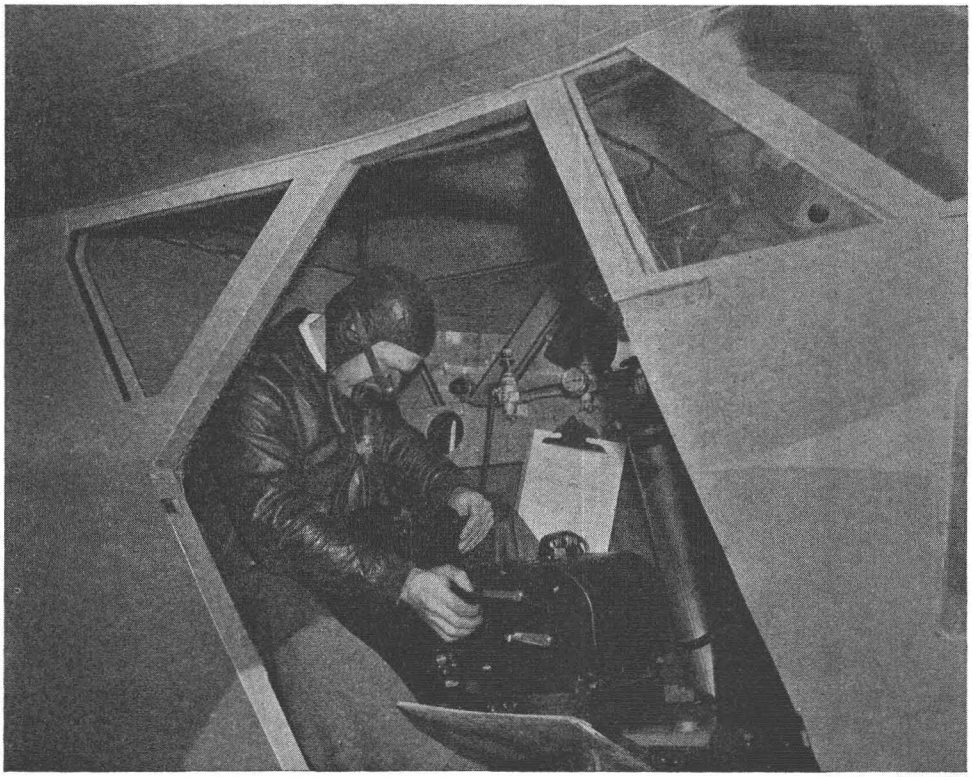

FIG. 3. Aerial Photographers and Camera Installation.

In most cases the pilot feels sure that he is the proper distance to the left of "A" while the photograph later shows that he was directly over "A." He goes confidently up the line, however, feeling sure he is "right on the nose." When he gets closer to "B" he sees that unless he does something quickly he will pass over or to the right of "B." He therefore starts kicking hard left. The photographer cannot keep up with these violent corrections and the result is a "snaky" line. The next line (#2) will probable also be "snaky" because in aerial mapping, errors hardly ever compensate; they invariably add up and the result is a gap between lines or too much overlap between others.

In the Instrument Method the drift would also be calculated by a trial or "dry" run and the pilot would note the heading on the directional gyro which would keep him on his proper course. He would be aided in this calculation by the aerial photographer using his view-finder as a drift indicator. The pilot now flies three or four miles south of the starting point and perpendicular to his

course. Let us say that he found on his trial run that a heading of 350° on the gyro was necessary to make good a course of true north. He therefore flys at approximately 270° and watches through the right window until he feels sure that he is the proper distance west of "A." He then starts his turn and concentrates on instruments, watching his gyro until it reads 350 degrees. He then straightens and checks his turn indicator, sensitive altimeter and air speed indicator. In the meantime the photographer is watching his view-finder. The view-finder has a level bubble and the photographer can always determine, therefore, what point he is directly over. He can also see features some distance ahead of the plane.

Looking through the view finder the photographer might see that the pilot has started too far to the east and will pass over point A instead of to the west of it. If the plane is too close for a correction he tells the pilot to start over again. If he thinks there is time to make the correction before reaching the boundary he might tell the pilot "you're too far east, kick it over about a quarter of a mile to the west and then back on course." The pilot kicks the plane quickly perpendicular to the left and then back again on his proper heading. The photographer checks and reports "that's O. K., hold it."

From there on the pilot concentrates on instruments and relies on the photographer to check the map and guide him. The photographer may find by checking his map that the heading was not correct and that the plane is drifting too far east. He reports: "you're drifting to the East, change your heading about 3 degrees to the West." The pilot looks at his gyro and changes his heading to 347°. A little later the photographer finds that they are right on the line but decides that the correction of three degrees was too much and will soon carry them too far to the West, so he reports: "Change heading 1° East." The pilot changes to 348° and holds until further corrections. He refrains from looking down the line thus giving the plane a chance to get off course. He flies almost entirely by instruments paying particular attention to the occasional correction of the directional gyro compass in comparison with the magnetic compass.

The result may not be a perfectly straight line. There may be a slight bend here and there, but with the crew acting as a team the result is good. Flying over country where check points are few and far between, the advantages of the Instrument Method over the Contact Method are more pronounced. In high altitude flying the Instrument Method again gains in advantage over the Contact Method because as a plane nears its service ceiling it becomes necessary to fly with the nose high to keep from losing altitude. In this position the contact flier will find more difficulty in checking but the instrument flier will get more help from his photographer because at high altitudes the exposure interval will become longer. This gives the photographer more time to check his maps between exposures and to guide the pilot.

In time of national emergency when experienced pilots are greatly in demand, a system of training new mapping pilots becomes all important. As observed before, a good Contact mapping pilot is "born, not made" but this is not so with an Instrument Method pilot. A study of the prerequisites of a good Instrument mapping pilot reveals the following:

(1) The ability to hold a straight and level course on instruments, keeping the compass to within two degrees, the sensitive altimeter to within plus or minus 200 ft. and the wings level, for thirty or forty minutes at a time if necessary.

(2) The ability to read maps at an average scale of 1 inch to the mile quickly and accurately, locating especially such features as small road intersections, streams, towns, etc. For instance, referring again to Figure 1, the pilot should be able to locate point "A" from the air and to get ready quickly to start the line.

In regard to the first requisite—the ability to fly by instruments—instrument flying is being taught all over the country and it is generally agreed that the Link Trainer is the best approach to this training. For our purposes radio and beam bracketing are unnecessary so that in four to six hours the student mapping pilot should have gotten the "feel" of flying on instruments and should be able to maintain straight and level flight without watching the ground or the horizon.

Next comes air work but, before the pilot goes aloft, he lays out flight lines on a map and these are studied and discussed at length by the student and instructor. The first ten hours of instruction should be given by an experienced Instrument mapping pilot. The plane should be a cabin type with side-by-side dual controls so that the instructor can sit alongside and constantly advise the student.

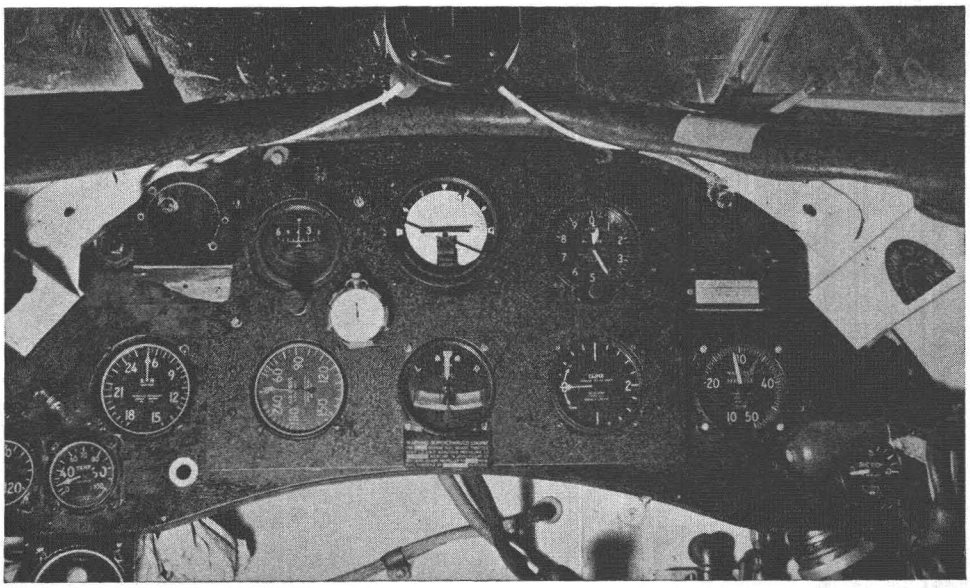

FIG. 4. Instrument Panel Showing Vital Instruments.

The first step in the air is practice in getting over a starting point. This is done by flying perpendicular to the line and some distance from the boundary, then turning into it when directly opposite, and straightening out on the "gyro." After this has been partially mastered the student tries flying straight lines for a distance of not less than ten miles without referring to the ground images. The instructor, sitting alongside the student, can check the student's progress by looking through the glass window in the floor. For this primary part of the training the weather need not be nearly as perfect as that needed for actual vertical mapping. Poor visibility and some clouds are no disadvantages as long as points on the ground can be checked occasionally. It is desirable to reach at least 8000 feet since at lower altitudes the air is too rough and the perspective much different than at the average mapping altitudes of 15,000 to 17,000 feet.

Ten hours of this—up and down longer and longer lines and with starting points increasingly harder to locate—and then the instructors shift and an ex-

perienced aerial photographer takes over. During the next five hours the photographer uses only the view-finder and the interphone system. He checks the student's course and corrects it to left or right as required. He insists on getting over the correct starting point and has the student repeat his starts until he hits it. The last five hours of instruction are the same except that now an aerial camera is used and exposures made at several points along the line. When developed the prints are laid out and the student can then actually see his mistakes and profit by studying them.

The training in the second requisite, the ability to read maps, goes on simultaneously with the training in the air. It is best in all flying training not to take too large doses at one time so about two hours at first and then later, three hours will give the best results. After flying, or on days when flying is not practicable, the student spends his time in the photographic laboratory. Here he develops his ability to read maps and to locate and orientate himself quickly in the air by studying the area covered by a vertical aerial photograph and then locating this same area on the line-drawn map used in flying. He does this by using a template, to the same scale as the flight map, which represents the area covered by each aerial negative. The print is studied, the template is laid on the corresponding area shown on the flight map and the four sides of the template outlined on the map with pencil or ink. This is called "indexing" or making an index map and print after print is indexed by the student, thereby greatly increasing his ability to locate small road intersections, etc. on the map, and on the aerial photograph which represents the picture he will see when he is in the air at altitude.

Thus the whole course of training takes four to six hours of Link Trainer time, twenty hours of flying time and two or three weeks of "dovetailing" laboratory time. With average weather conditions a month should cover everything.

The minimum instruments required are shown in the accompanying picture and include: Turn-and-Bank Indicator, Rate-of-Climb Indicator, Directional Gyro Compass, Magnetic Compass, Sensitive Altimeter, a good two-way interphone system between pilot and photographer, and if possible, a glass window under the pilot's feet to help him in locating and starting a line.

In conclusion it is believed that the Instrument Method of aerial mapping has many advantages over the Contact Method. It can be and has been used successfully over all types of terrain. Many thousands of square miles of high standard aerial surveys attest to the efficiency of this system. It can be used successfully in planes which would not be suitable in contact flying. It can be taught quickly and successfully to pilots who can adapt themselves to instrument flying, whether their hours of flying are many or comparatively few.
