EXPERIMENTS WITH THE STATOSCOPE
by
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Recent issues of the News Notes have carried frequent references to the use of statoscopes and their application to aerial photogrammetry. Some experimental work was done with statoscopes by Brock and Weymouth between 1928 and 1930, and a brief report on the results may be of interest at this time.

In the Brock and Weymouth process, the difference in height between adjacent exposure stations is called "scale change" and is expressed in thousandth parts of the lens height, rather than in feet. If picture #2 of pair 1-2 receives an enlargement of 0.003, it means that it was taken at a point 3/1000 of the lens height higher than picture #1, and therefore must be enlarged this amount to bring it to the scale of picture #1. With suitable ground control, the difference in height between exposure stations can be determined from a tilt analysis of the pair, but it was soon learned that some office labor could be saved if an instrument were used to supply the information directly.

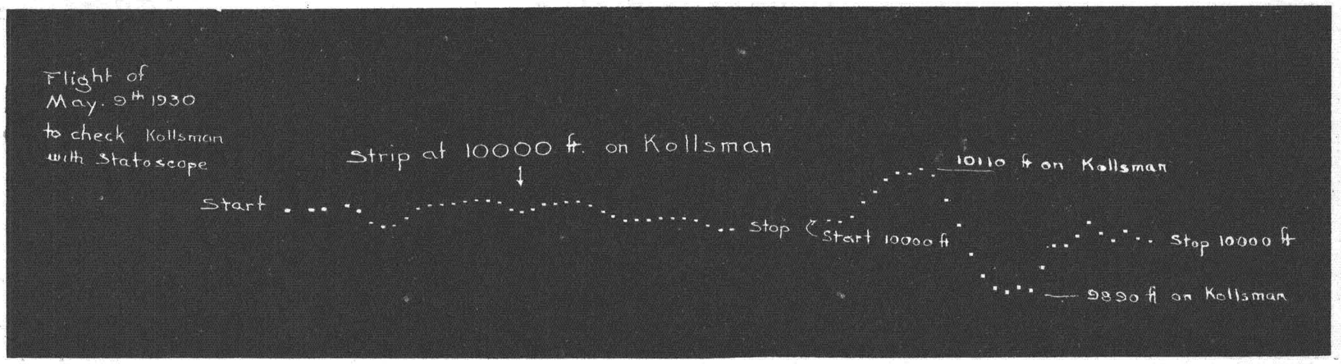
Early in 1928, Mr. T. P. Pendleton and others of Brock and Weymouth with the advice of Mr. H. J. E. Reid, of the National Advisory Committee for Aeronautics, adapted the standard N. A. C. A. Recording Statoscope to Brock and Weymouth's particular requirements. This pressure measuring device may be briefly described as a thin diaphragm with one face exposed to the atmospheric pressure, and the other connected with a closed, constant temperature air reservoir such as a thermos bottle. A suitable valve is provided to open and close the air reservoir to atmospheric pressure. Differences in air pressure resulting from changes in altitude of the airplane actuate the diaphragm when the valve of the air reservoir is closed. This slight motion is used to rotate a delicately balanced mirror. The recording device consists of a light source to illuminate the mirror, a lens to focus the mirror on the record film and provision for moving the film forward between each exposure. A suitable switch, actuated when the camera shutter is tripped, causes the statoscope light to flash momentarily and record the position of the mirror at that instant. By this arrangement, the statoscope can be placed in any convenient position in the airplane. It was found advisable to attach the open side of the diaphragm to the static head of a pitot tube fastened to the strut well outside the propeller slipstream. The valve attached to the thermos bottle was closed only when the airplane was being flown on a level photographic flight because the sensitivity of the device was so great that its calibration factor would be endangered if carried much beyond plus or minus 100 feet at 10,000 feet, the altitude for which the instrument was calibrated.

The first experiments were conducted in 1928 over the Brock and Weymouth Doylestown, Pennsylvania, test area, which had previously been mapped by the Brock process and then rigorously checked by ground parties. By empirical methods, it had been determined that a knowledge of the difference in height of the two exposure stations would enable the photogrammetrist to determine, for both pictures of a pair, the tilt around an axis perpendicular to the flight line without any ground information at all. Five plates were corrected for tilt using the statoscope readings in this way, and these values were compared with the actual values obtained when the plates were corrected in the usual manner. In three of these plates the statoscope method gave tilts within three minutes of the value obtained by the usual method, while in the fourth plate there was a discrepancy of twelve minutes, and in the fifth plate there was a difference of eighteen minutes. In this test the tilt around the other axis (parallel to the flight line) was determined from the parallaxes of three points of known elevation. Using the values of the tilts obtained by these two methods, the plates were reprojected to the "horizontal" and read on the stereoscopes. It was found that all points were within one contour interval of the correct elevation, or within 20 feet on a map at a scale of 1:24,000.

Later another test was run over the same area with a different set of plates.

When these were corrected by the usual method, the scale change employed did not depart more than 0.0005 (or 5 feet at the elevation at which these pictures were taken) from the values given by the statoscope. A rough correction was given five plates to further test the possibility of using very limited ground control if the statoscope were employed. The maximum difference between the tilt as determined by the rough correction and the regular correction was ten minutes and the minimum difference was three minutes.

The statoscope received a much more thorough test under actual working conditions on the Wabash River Survey, made in 1929 for the U. S. Engineer Corps. Statoscope readings were available for seventy-five pairs. In fifty-three of these pairs the scale change used in actual correction was within 0.0005 (6 1/2 feet at this lens height) of the value given by the statoscope. Nine pairs had scale changes differing by between 0.0005 and 0.001 from the statoscope readings, and nine pairs used scale changes differing by more than 0.001 from the statoscope value, with a maximum difference of 0.00375.



The sensitivity of the instrument as compared with a high grade altimeter, ordinarily used in airplane flights, is shown in Figure 1. This record shows first, the variations in altitude that occurred while the pilot was holding the ship level at 10,000 feet and second, the response of the statoscope to deliberate changes of altitude. On this record the variations in altitude are shown as ordinate differences on the film, 0.01 inch corresponding to 2.46 feet. The left half of the record shows continuous changes in altitude not indicated on the ship's altimeter, the maximum variation being of the order of fifty feet. The right half of the record shows the response of the statoscope to changes in altitude of 100 feet. It is of interest to note that both records indicate that the airplane was lower at the end of each test than it was at the start. It is possible that this was due to lag in the altimeter in the second test, but it is not likely to be true in the first test which was at a constant altitude.

This work was all done to test the probable accuracy of the statoscope, since at the time no one seemed absolutely certain that there might not be minor pressure changes in the atmosphere that would cause slight errors when the statoscope readings were interpreted as feet of elevation difference. One fact is perhaps interesting in this connection. In no case did the statoscope indicate that a given plate was high when actual correction showed it to be low, or vice versa.

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