PERFORMANCE

Maximum Speed (Sea Level)	185 Miles per hour
Maximum Speed (10,000 Feet)	200 Miles per hour
Cruising Speed 2,000 R.P.M.	165 Miles per hour
Landing Speed	66 Miles per hour
Rate of Climb	1,800 Ft. per minute
Service Ceiling	21,000 Ft.
Cruising Range	1,400 Miles

POWER PLANT

Engine Wright R975-E 330 H.P. at 2100 R.P.M.

Last week the Abrams Air Craft Corporation of Lansing, Michigan was formed to develop and manufacture the new type of aircraft described in this article, of which the officers are the following:

President: Talbert Abrams
Chief Engineer: Kenneth Ronan
Test Pilot: Walter Carr

A TIMBER SURVEY CONTROLLED BY AERIAL PHOTOGRAPHS

By Joseph G. Kelley, Jefferson National Forest

Ground surveys are necessary for the control and accurate use of aerial photographs, but it is only rarely that the requirements are reversed and the aerial photographs are used to control ground surveys. Photographs have been successfully used to control a timber survey.

On forest lands where timber management plans are to be initiated, it is essential to have an accurate knowledge of the present resources of the forests and sufficient data to anticipate future yields. For this purpose it is necessary to take an inventory of the present resources of the forest lands - that is, a timber survey.

Obviously, it is impossible to measure the height and diameter of every tree, so compass lines, called strip lines, are run parallel at regular intervals and sample plots are taken at specified points along the strip lines. The volume and the species of the timber are measured accurately in these sample plots and factors such as drainage, condition of the soil and presence of fungi and insects are noted. From a compilation of the sample plots, an accurate picture of the area may be drawn and future prospects closely anticipated.

It is necessary to have some method of controlling the strip lines. The practice in the past has been to use compass and tape traverses to determine the position of control points for the strip lines. These traverses are run between control points of a higher order and are run along the ridge tops which form the boundaries between logging units. At intervals of about ten chains, trees are blazed and scribed with an identifying number so that the crews running the strip lines may tie into them. The control work is done by a five-man crew and progress of the work is delayed by the necessity of cutting brush, so that two and a half to three miles of traverse is considered an excellent day's work.

In order to substitute an aerial photograph method of control for the compass method, it was necessary for the aerial method to show a decrease in

COST, ACCURACY WITHIN THE ALLOWANCE FOR A PLOTTABLE ERROR, AND A ROUTINE WHICH WOULD NOT INVOLVE A HIGHLY TECHNICAL PROCEDURE. PHOTOGRAPHS AND RADIAL CONTROL WERE AVAILABLE IN THE AREA.

ON A STEREOSCOPIC PAIR OF VERTICAL AERIAL PHOTOGRAPHS ON A SCALE OF 1:24,000 IT IS DIFFICULT TO IDENTIFY A SINGLE TREE IN A WOODED AREA, AS HEAVY FOLIAGE PREVENTS THE OBSERVER FROM ORIENTING HIS POSITION ON THE GROUND IN RELATION TO OTHER TOPOGRAPHIC FEATURES WHICH HE CAN SEE ON THE PHOTOGRAPH. FURTHERMORE, ON THIS SMALL SCALE, DISTINGUISHING CHARACTERISTICS BETWEEN INDIVIDUAL TREES ARE NOT APPARENT. ON A DENSELY WOODED RIDGE TOP, THE OBSERVER SOON BECOMES LOST ON THE PHOTOGRAPH UNLESS HE HAS SOME WAY OF OCCASIONALLY TIEING HIS POSITION INTO POINTS OF UNQUESTIONED IDENTIFICATION. HOWEVER, THERE ARE ALWAYS SOME IRREGULARITIES IN THE RIDGE TOPS, SUCH AS SMALL KNOLLS AND SADDLES. THE RESTRICTED AREA OF THESE POINTS ASSISTS IN THE POSITIVE IDENTIFICATION OF AN INDIVIDUAL TREE. THESE IRREGULARITIES MAY OCCUR AT INTERVALS SUFFICIENTLY CLOSE ENOUGH TO TEN CHAINS SO THAT THEY CAN BE USED FOR CONTROL POINTS. UNFORTUNATELY, NATURE HAS NOT ALWAYS PROVIDED THESE BUMPS AND DEPRESSIONS AT INTERVALS SUFFICIENTLY CLOSE FOR THE REQUIREMENTS OF THE WORK. OFTEN RIDGE TOPS DO NOT SHOW ANY IDENTIFIABLE CHARACTERISTICS FOR ONE-HALF TO THREE-QUARTERS OF A MILE.

IN SUCH CASES THE FOLLOWING METHOD WAS DEVISED AND IS DEPENDENT UPON A RADIAL-TEMPLET COMPILATION ON A 1:15,840 SCALE:

A SCALE WAS SUPPLIED BY A MANUFACTURER WHICH CONTAINED NINE FIFTY CHAIN LENGTHS ON RATIOS OF 1:20,592; 1:21,384; 1:22,176; 1:22,968; 1:23,760; 1:24,552; 1:25,344; 1:26,136; 1:26,928. THESE ARE MARKED 1:30; 1:35; 1:40; 1:45; 1:50; 1:55, 1:60; 1:70, RESPECTIVELY. THESE MARKINGS INDICATE THE RATIO FACTOR NECESSARY TO ENLARGE A POINT ON THE CONTACT PRINT TO THE RADIAL COMPILATION SCALE OF 1:15,840. THESE DESIGNATIONS ARE USED SO THAT THE CONVENIENT GRAPHIC METHOD OF DETERMINING RATIO FACTORS AS DISCUSSED IN THE NEWS LETTER OF JULY, AUGUST, SEPTEMBER, 1936 CAN BE APPLIED.

BEFORE FIELD WORK IS ATTEMPTED, RATIO FACTORS ARE DETERMINED FOR EACH RIDGE TOP AND FOR POINTS OF EXCESSIVE CHANGE IN ELEVATION ALONG A RIDGE. THE RATIO FACTORS ARE NOTED ON THE FIELD SET OF PHOTOGRAPHS AND DESIGNATE WHICH SCALE TO USE ON A GIVEN RIDGE. THE PROPER SCALE MAY ALSO BE DETERMINED BY SCALING A DISTANCE WITH A 1:15,840 SCALE FROM A RADIAL INTERSECTION POINT ON THE RIDGE TO THE CENTER OF THE PHOTOGRAPH, AS SHOWN ON THE 1:15,840 COMPILATION. APPLY VARIOUS PARTS OF THE PHOTOGRAPHIC SCALE BETWEEN THE SAME POINTS ON THE CONTACT PHOTOGRAPH UNTIL THE SAME DISTANCE IS READ AS WAS OBTAINED ON THE 1:15,840 COMPILATION. THE SCALE MAY ALSO BE DETERMINED BY PROPORTION. THE SCALE DETERMINED IN THIS MANNER MAY BE USED ON THE RIDGE FOR WHICH IT WAS DETERMINED AS LONG AS THE RIDGE TOP DOES NOT CHANGE GREATLY IN ELEVATION AND ONLY ON PHOTOGRAPHS WHICH DO NOT SHOW EXCESSIVE TILT. THE SCALE WILL BE CONSTANT, WHETHER IT IS USED NEAR THE CENTER OF THE PHOTOGRAPH OR NEAR THE EDGE. FOR RIDGE TOPS WHICH VARY GREATLY IN ELEVATION OR ON PHOTOGRAPHS WHICH ARE TILTED, SCALES MAY BE DETERMINED FOR CRITICAL POINTS AND INTERPRETED FOR INTERMEDIATE POINTS.

IN THE FIELD, THE OBSERVER NOTES THROUGH THE STEREOSCOPE WHERE THE NEXT POINT OF POSITIVE IDENTIFICATION WILL BE ON THE PHOTOGRAPHS. USING THE PROPER SCALE, AS PREVIOUSLY DETERMINED, HE ANTICIPATES THE NUMBER OF CONTROL POINTS THAT IT WILL BE NECESSARY TO SET BEFORE HE REACHES THE NEXT IDENTIFIABLE POINT. HE IS ACCOMPANIED BY TWO CHAINMEN. THE CHAINMEN MEASURE APPROXIMATELY TEN CHAINS, BLAZE AND SCRIBE A CONVENIENT TREE FOR A CONTROL POINT, AND THE OBSERVER NOTES THE DISTANCE IN HIS NOTEBOOK. THEY CONTINUE TO SET CONTROL POINTS AT THE PROPER INTERVALS UNTIL THE IDENTIFIABLE POINT IS REACHED. NO BRUSH IS CUT. THE CHAINMEN FOLLOW THE RIDGE TOP AND PULL THE TAPE TIGHT AT THE END OF EACH FULL LENGTH. VERTICAL ANGLES ARE NOT NOTED UNLESS THEY EXCEED FIFTEEN DEGREES. THE OBSERVER TOTALS THE DISTANCE CHAINED BETWEEN IDENTIFIABLE POINTS AND CHECKS THIS AGAINST THE SCALED DISTANCE ON THE PHOTOGRAPH. THIS USUALLY

CHECKS EXACTLY, BUT SOMETIMES AN ADJUSTMENT OF A FRACTION OF A CHAIN MUST BE MADE. THIS ADJUSTMENT, IF NECESSARY, IS DISTRIBUTED PROPORTIONATELY OVER EACH OF THE SEVERAL INTERMEDIATE COURSES. WHERE SUCH ADJUSTMENTS HAVE BEEN MADE, THE ACCURACY OF THE RESULTS HAS NOT BEEN EFFECTED. ERRORS IN CHAINING CANNOT ACCUMULATE BEYOND POINTS OF POSITIVE IDENTIFICATION. AZIMUTH IS DETERMINED FROM POINT TO POINT BY RADIAL INTERSECTION IN THE OFFICE.

IN ORDER THAT THE CHAINMEN WILL NOT BECOME LAX IN THEIR WORK, THEY ARE REQUIRED TO CHAIN CONTINUOUSLY, EVEN BETWEEN POINTS OF POSITIVE IDENTIFICATION. THE CHAINED DISTANCES BETWEEN POINTS OF POSITIVE IDENTIFICATION ALSO FURNISH PROOF OF THE IDENTIFICATION.

OCCASIONALLY RIDGE TOPS BECOME FLAT AND WIDE SO THAT IT IS DIFFICULT TO DETERMINE THE CREST FROM THE PHOTOGRAPHS. FOR THESE EXCEPTIONAL CASES, COMPASS AND TAPE TRAVERSES ARE RUN FROM IDENTIFIABLE POINTS.

FROM THE RESULTS OBTAINED IN AN EXPERIMENTAL AREA CONTAINING SIXTEEN MILES OF CONTROL, A SAVING OF FIFTY PER CENT IN COST WAS INDICATED.

OFFICE PROCEDURE CONSISTS FIRST OF TRANSFERRING THE CONTROL POINTS FROM THE FIELD SET TO THE OFFICE SET OF PHOTOGRAPHS. THEN THE OFFICE PRINT IS ORIENTED TO ITS CORRECT RELATIONSHIP TO THE RADIAL LINES ON THE RADIAL COMPILATION SHEET. THE RADIAL LINES FROM THE CENTER OF THE PHOTOGRAPH TO THE CONTROL POINTS ARE TRANSFERRED TO THEIR RELATIVE POSITIONS ON THE COMPILATION SHEET BY THE USE OF THE DRAFTING MACHINE. INTERSECTIONS OF RAYS FROM TWO OR MORE ADJACENT PHOTOGRAPHS DETERMINE THE LOCATION OF A CONTROL POINT. THE AMOUNT OF WORK INVOLVED IN PLOTTING CONTROL BY THE AERIAL METHOD IS SLIGHTLY LESS THAN THAT REQUIRED FOR THE COMPASS TRAVERSE METHOD.

FOR THE CONVENIENCE OF THE OBSERVER, A FIELD STEREOSCOPE MOUNTED ON A LIGHTWEIGHT TRIPOD WAS USED. THE OBSERVER'S EQUIPMENT, INCLUDING A COMPASS, IS ILLUSTRATED IN THE ACCOMPANYING STEREOGRAM.