

three of the film rolls. Each roll contained 250 exposures. The temperatures outside were around zero degrees Fahrenheit and with a coal stove heating the Science Building, it was difficult to keep an even temperature of the chemicals and the rinsing water. Snow and ice blocks were melted in our galley snowmelter, and by carrying numerous buckets of water from the galley, through the tunnel to the Machine Shop and from there through another tunnel to the Science Building, he and his helpers were able to build up a couple of drums of water reservoir which was pumped up into a tank located in the overhead. It was a continuous job, of twelve hours' duration, to develop one roll of film. After developing one of these rolls, Latady usually turned into his bunk some time in the wee hours of the morning. Because of our lack of proper facilities, only three test rolls of the trimetrogon films were developed by him while we were still in the Antarctic. The results were excellent and I see no reason why the other 59 rolls which are now in Florida should not turn out equally well. While I have brought back the pictures and ground control points, I am fully appreciative of the great complexity and magnitude of the work that remains to be done.

I am truly glad to have had this opportunity to appear before the Photogrammetry Society, because ultimately it will be through the understanding and capabilities of some of your members that the pictures which we have taken will be transformed into maps. There is, of course, no need for making a detailed contour map over the Antarctic at this time. It is my hope that a map will be made so that the features and their naming can be easily recognized by future explorers who will endeavor to carry on further, beyond the limits of our discoveries. It is also my hope that the whole of Antarctica some day, perhaps within our lifetime, will have been seen by man, and from my experience on this Expedition, I am convinced that with good planes and determined personnel, the trimetrogon cameras will make this possible.

It is my belief that the pictures and the ground control resulting from the Expedition will be sufficient to enable you to produce satisfactory maps. I wish to thank you in advance for the contributions which you will necessarily make during the course of this work.

REPORT ON THE AERIAL PHOTOGRAPHY OF THE RONNE ANTARCTIC RESEARCH EXPEDITION*

William Robertson Latady

PREPARATION

ARRANGEMENTS were made to obtain a C-45 at Panama as a replacement for the plane abandoned at the Pennsylvania Shipyard in Beaumont, Texas. The modification work, including the trimetrogon installation, was to be accomplished by personnel on board ship while traveling south. Air Force officers, Captain Lassiter and Lt. Adams were assigned to the Expedition.

The C-45 was loaded on board the ship in Panama, along with all the equipment taken out of the first C-45, which Lassiter and Adams had brought down in a C-47. Albrook Field had been able to put in a 43 gallon nose tank and give the plane an important coat of paint, two toned red and yellow, so that it would stand out against the snow.

* Submitted June, 1948.

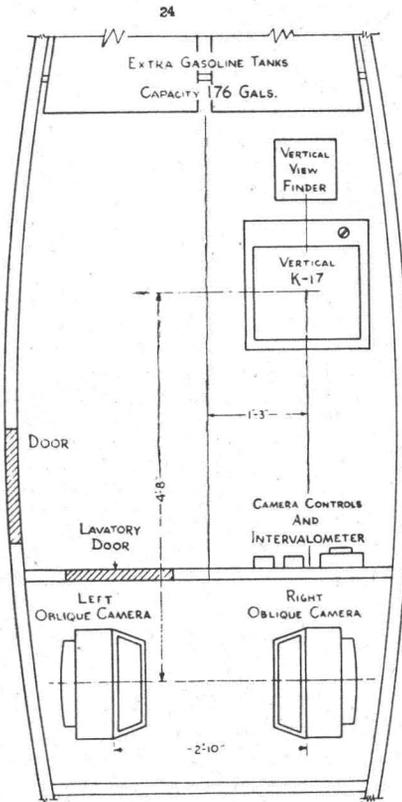
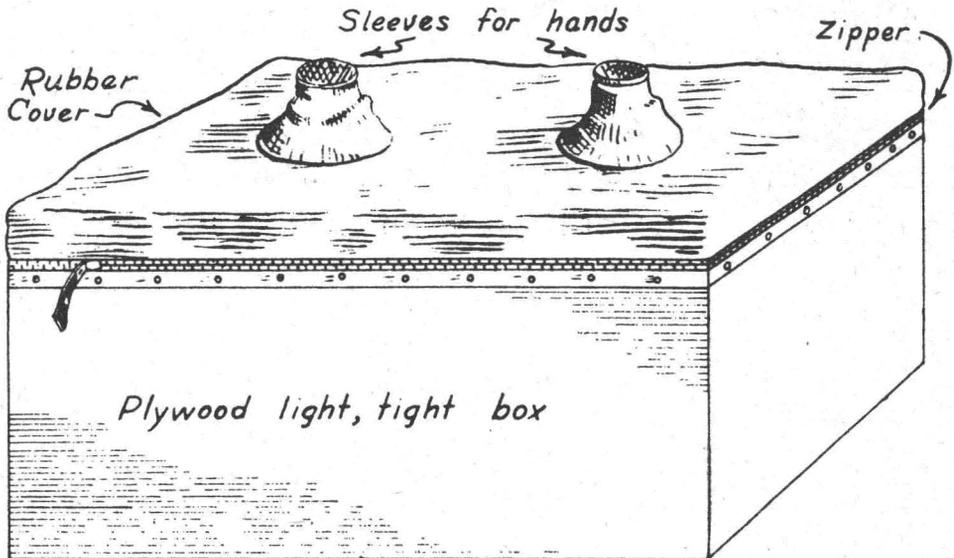


FIG. 1

Position of the three cameras in the fuselage of the C-45 Beechcraft Plane.

In the two weeks between leaving Panama and arriving in Valparaiso, aviation mechanic James Robertson did the major job of fitting the new plane for our purposes. Many other people helped when not on watch; Kelsey, our radio operator, helped with that end; pilots Adams and Lassiter helped wherever needed and I helped with the installation of the cameras. To save time, the vertical camera, in the trimetrogon setup, was removed from its place between the two obliques, forward to a position on the right side of the plane. (See Fig. 1.) This made it unnecessary to reroute all the control cables going to the tail, a tricky job at best. Two gasoline tanks, totaling 176 gallons were installed inside of the fuselage; this, with the nose tank, gave the plane a maximum of 406 gallons of gasoline, an estimated ten hours cruising time. In order to carry all the extra equipment, every bit of unnecessary material was removed from the inside and outside of the plane; all seats, upholstery, lights and even the wooden slats that held the upholstery. The final work of checking the fuel system, the radio, and lining up the cameras, was left until we arrived in Antarctica. A rolling ship is not the best place to do fine work.



DRAWING NUMBER 1

Box, used as darkroom in the C-45 on all photographic flights, to change film in the magazines.

The Beechcraft remained aboard the ship all winter. Winter in the polar regions traditionally is reserved for preparations for the coming field season. Our winter was no exception. No vertical view finder had been included in the original setup and I felt that in a country of such uneven topography, it would be invaluable. Therefore, I designed and made a combination drift meter and vertical view finder, using the lens from an extra K-17 camera. (See Figure 4.) Our program called for long flights at low altitudes for mapping. This would mean taking many photographs if the desired 60° overlap were obtained in all cases. There were only five film magazines available, not enough for a complete change, which meant that the film would have to be changed in flight. Ac-

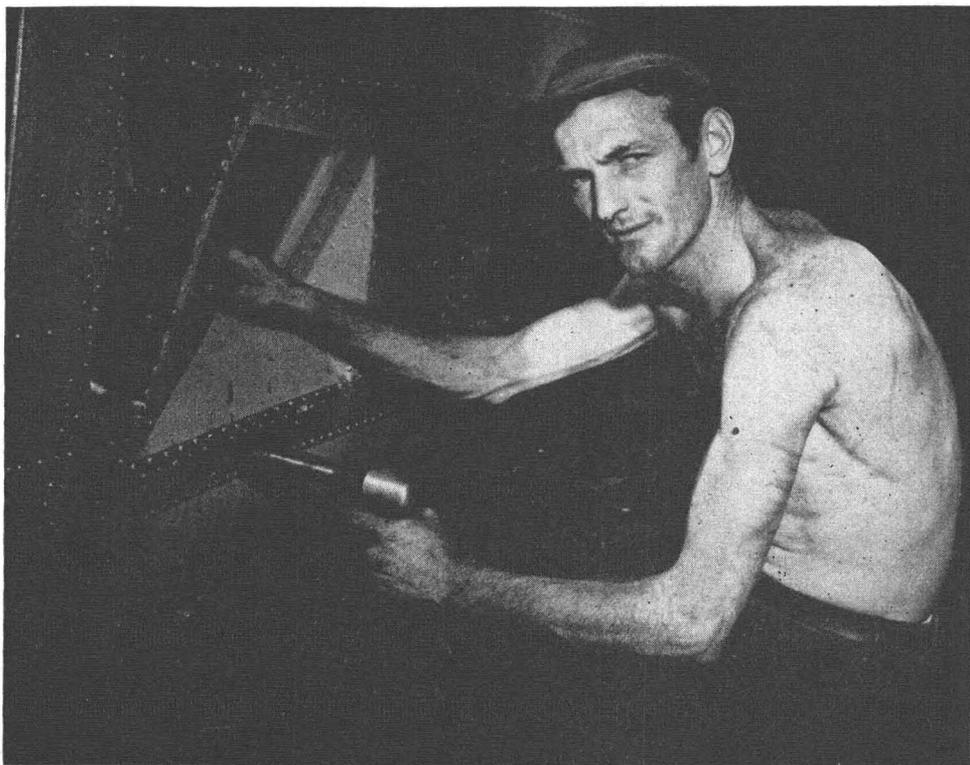


FIG. 2. James Robertson, installing camera window in C-45.

ordingly, I made a light, plywood box with a zipper light proof top, to act as a dark room. Although far slower than changing film in a dark room, it proved satisfactory. (See Drawing No. 1.) I also added an altimeter on the rear panel beside the intervalometer so that it would be easier to record the pressure altitude along with the altitude taken from the radio altimeter, which we installed later on the same panel. (See Figure No. 6.)

After a long, dark winter, the sun returned and the C-45 was taken off the ship and brought ashore where the final work was done. This took many days since there was little shelter from the wind and weather and early spring is still very cold in Antarctica. Because of many obstacles, the only practical method of lining up the cameras, one with another and the whole group with the plane, was with a bubble level. The plane was jacked up to its flying attitude according to the leveling lugs. (See Figure No. 9.) The vertical camera was

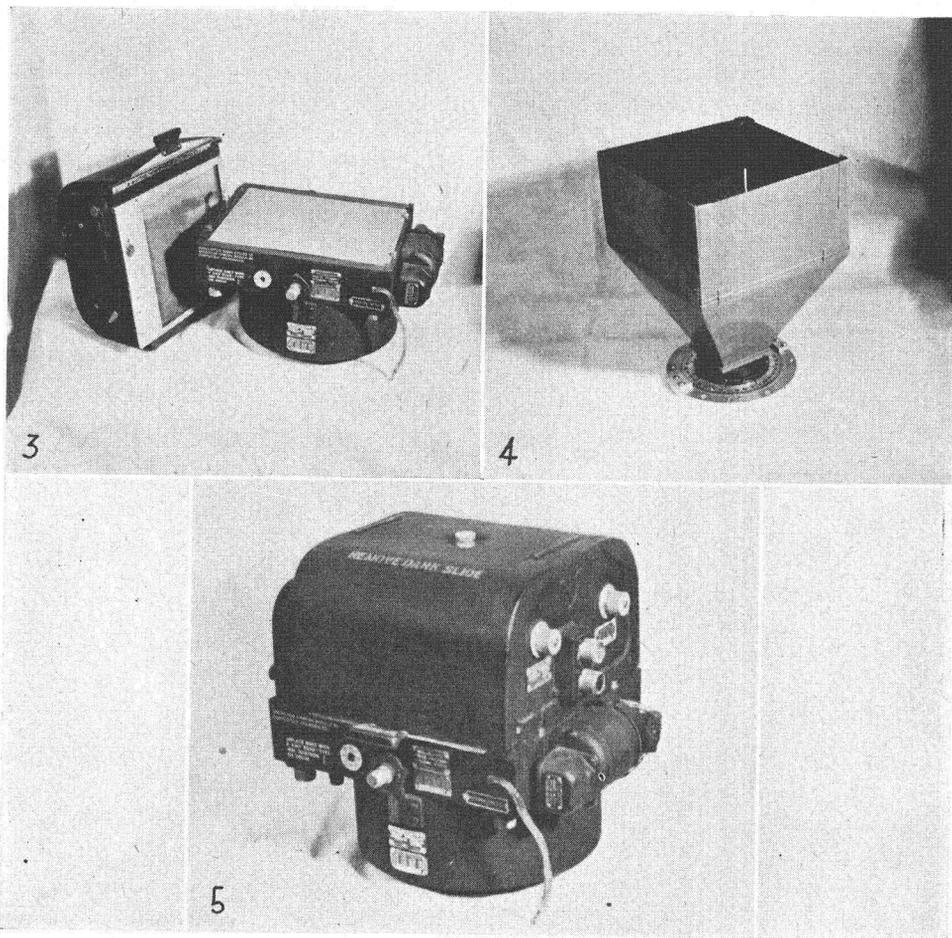


FIG. 3. K-17 cone and drive with cover and magazine.
 FIG. 4. Antarctic made, vertical view finder and driftmeter.
 FIG. 5. K-17 complete.

leveled fore and aft and athwart ships with the bubble level and measured with dividers from a center line to eliminate skew. (The bubble level was an adaption from a telescopic alidade. The bubble moved $\frac{1}{8}$ of an inch when a .003 of an inch piece of paper was slipped under one end of its 3 inch length.) The two obliques were leveled in much the same manner, the only difference being that a 30°, 60°, 90° triangle was used to get the proper angle and to make it possible to use the flat level. The drift lines on the combination vertical view finder and drift meter were also lined up with the same center line.

FLIGHTS

On October the 26th, after a preliminary test flight for the plane, the first photographic hop was made. This was a short flight to test the alignment and operation of the cameras. Only one-third of a roll of film was loaded in each

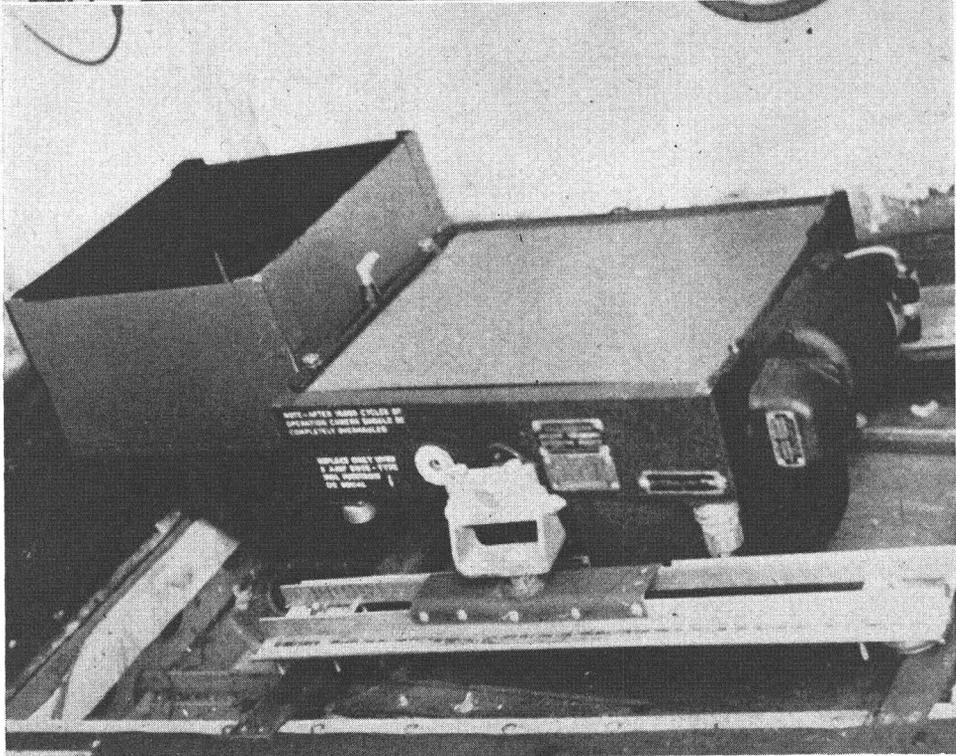
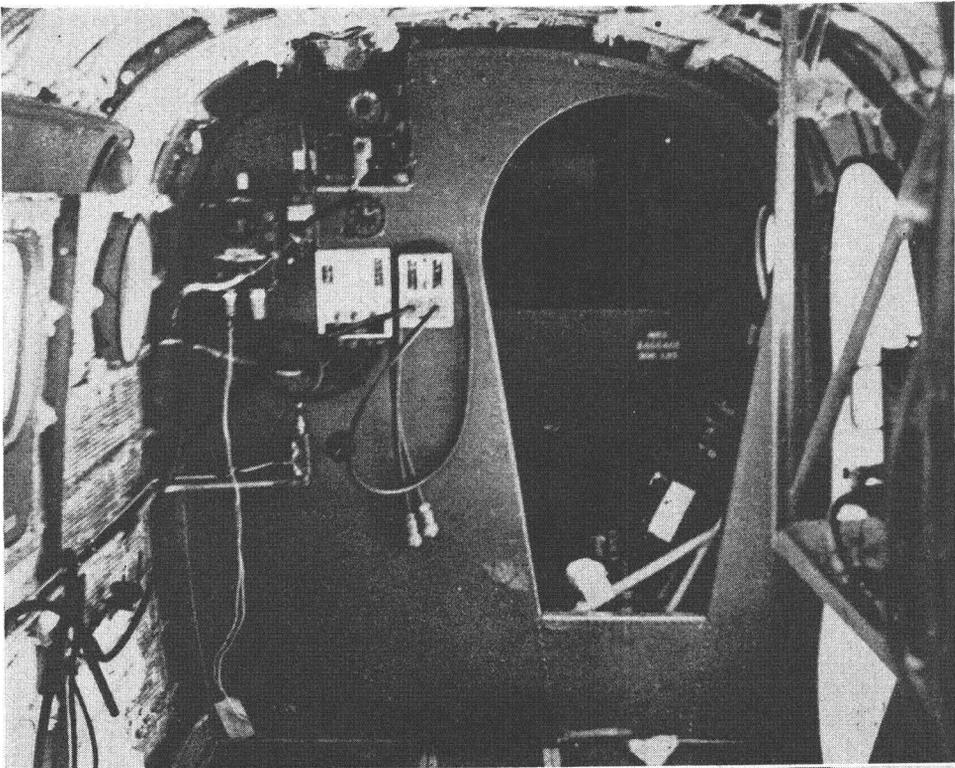


FIG. 6. Rear panel with intervalometer, pressure altimeter and radio altimeter, and connections. Left oblique camera showing through door.
 FIG. 7. Vertical view finder and vertical camera with cover but without magazine.

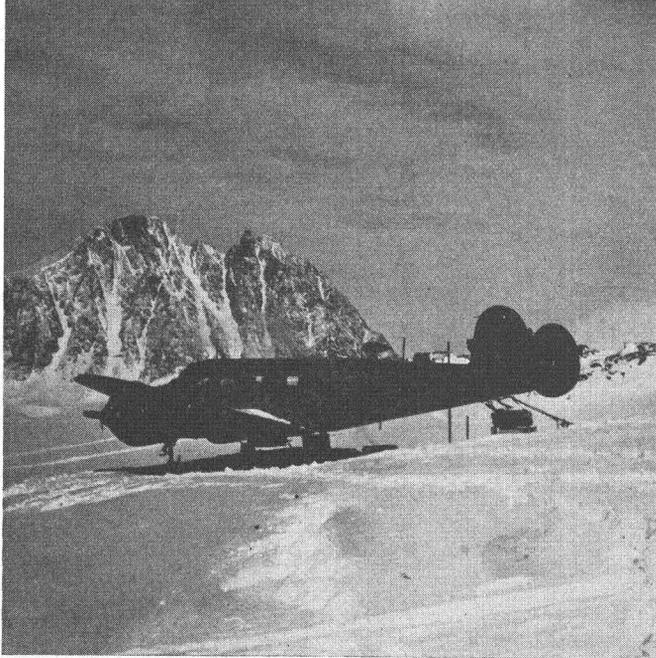


FIG. 8. C-45 on ship just before being taken off.
FIG. 9. C-45 jacked up for camera alignment.

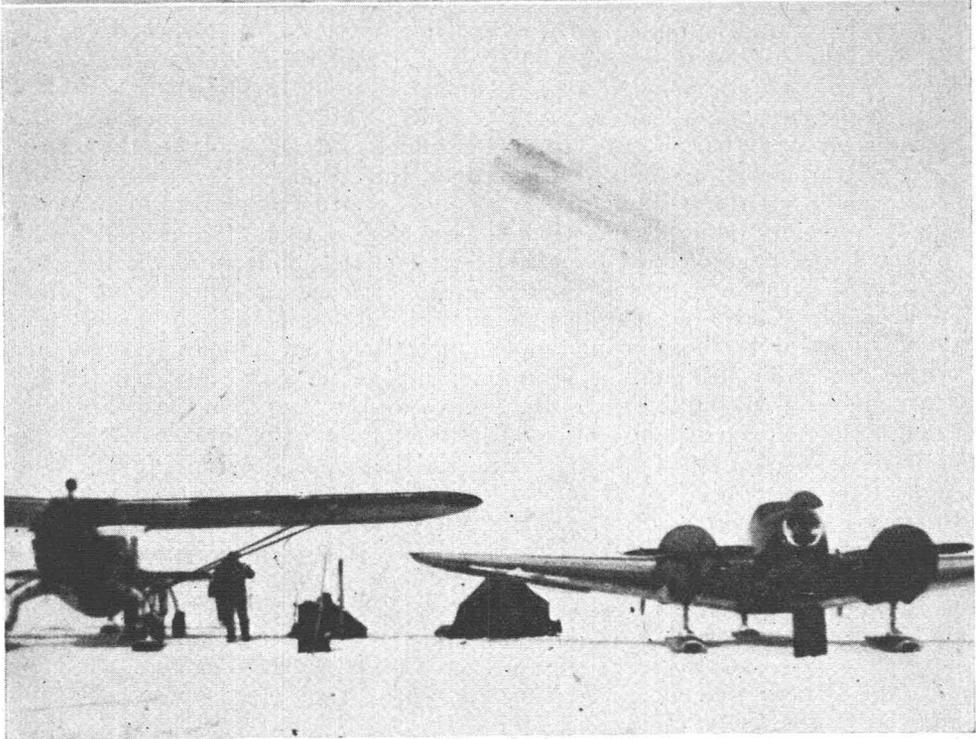
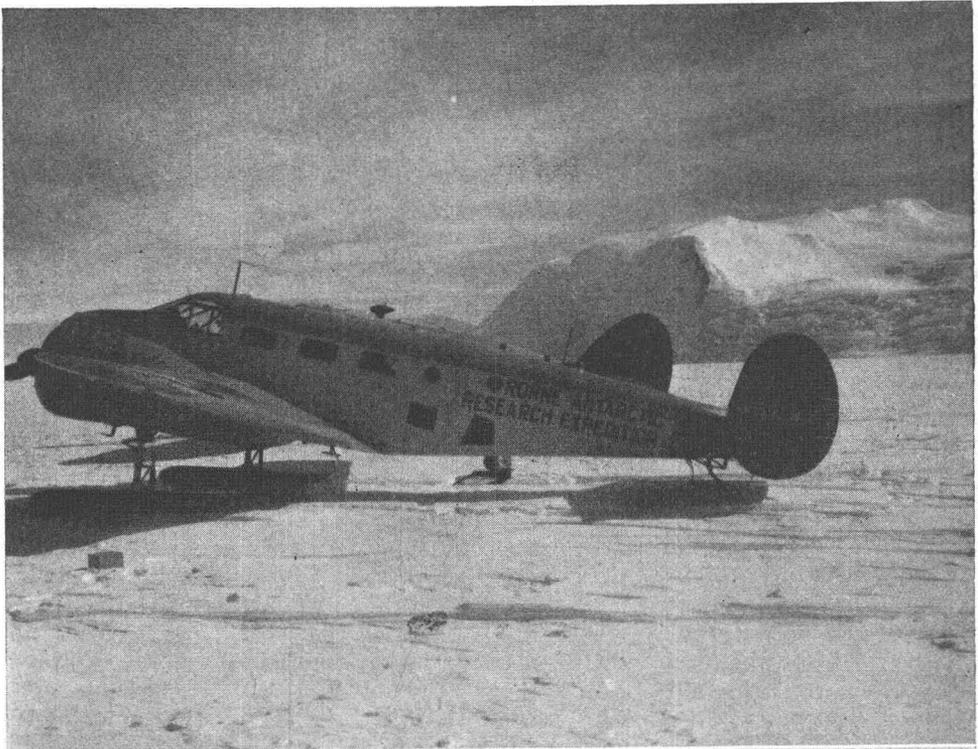


FIG. 10. C-45 landed in Gardner Inlet next to Mt. Austin for refueling.
FIG. 11. Forced down near Steele Island for the night. C-64, two tents and C-45.

camera magazine; later they were attached one to the other and processed together in order to assure an even development. Captain Lassiter flew the plane to 11,000 feet and I started the cameras. We flew south for 60 miles, turned and came back over base. Although the sky had been clear when we left, there were high cumulus clouds forming rapidly as we gained altitude so that we were forced to make the flight at varying altitudes. Even on this short run the weather had closed in on us somewhat, an indication of what we were to expect later. I tried various shutter speeds and different lens openings, using the same filter all the time. I tested the view finder and varied the intervalometer setting accordingly. On this flight only the altitude of the plane varied. The level of the terrain below was constant, since we were over bay ice. Time did not allow the radio altimeter to be tested, nor were the extra heaters tested because they were unnecessary for such a short run. The last photographs over the base were taken at 6,000 feet merely to run the film out. I never expected that we would be taking mapping pictures at this low altitude later on. The cameras had worked satisfactorily. Now to see the results on the negatives.

The small dark room at the base had to be changed over to accommodate the aerial processing equipment. Large quantities of water were carried in buckets to the science building and the special chemicals were mixed. The three exposed rolls were attached together and processed as one. The results showed that the cameras were well lined up and the different densities of the negatives were used as a basis for the photographs taken on the succeeding flights.

Everything was ready now for the first long photographic flight. However, it was not until November the 21st, that Comdr. Ronne, Capt. Lassiter and I were able to take off after waiting for three weeks for the weather to clear. We flew to Cape Keeler, a gasoline cache and meteorological station 125 miles south-east of camp, refueled and then went south along the coast to what was indicated on the map as George Bryan Inlet and which was later called Gardner Inlet. We were accompanied by Lt. Adams and Comdr. Schlossback in the C-64 cargo plane carrying a load of gasoline. Both planes flew at an altitude of approximately 2,000 feet in order to save gasoline, and consequently the cameras were not turned on. We landed at Gardner Inlet and refueled the C-45 from the drums inside the C-64. Pilot Adams and Co-pilot Schlossback remained on standby, while Comdr. Ronne, Capt. Lassiter and I took off and headed south to follow the range of mountains that formed the mountain chain along the Weddell Coast. When we were at 8,000 feet, I turned the cameras and all the auxiliary equipment on. The load under the existing conditions (-30°C) was too great for all the equipment and the main fuse blew immediately. I disconnected the radio altimeter, all five magazine heaters, and replaced the fuse. The cameras worked fine for the first four exposures, and then the right oblique camera ran continuously but did not wind the film nor the shutter. This seemed disastrous since it was the inboard camera, the one photographing the mountains. I took several K-20 shots and then decided that they would not replace the K-17, so concentrated on repairing the broken camera. It took an hour of hard work with the limited tools available, then it only worked intermittently. During this time, as at so many other times later when I was changing film, no data was recorded. At other times I took a running record of the following: temperature, air speed, altitude, intervalometer setting (number of seconds between exposures), shutter time and aperture of all three cameras, and time in GMT that any change took place, as well as time of change of magazines and the number of exposures on each.

We flew for an hour and a quarter following the coastal mountains which made a sweeping arc from a southerly direction to the west, finally diminishing

to a few isolated peaks more than 100 miles to the west and no visible mountains south and southeast. At this point, we turned around and retraced our outward track, but a little to the left of it, until we were in sight of Gardner Inlet. Here we changed course to follow the edge of the shelf ice, which went in a southeast direction. We followed the shelf ice for an hour and ten minutes, then turned around and came back to the cache at the inlet. The right oblique camera had worked spasmodically for the rest of the trip after being fixed. We landed six hours and forty-five minutes after the take off. The cameras were on for five

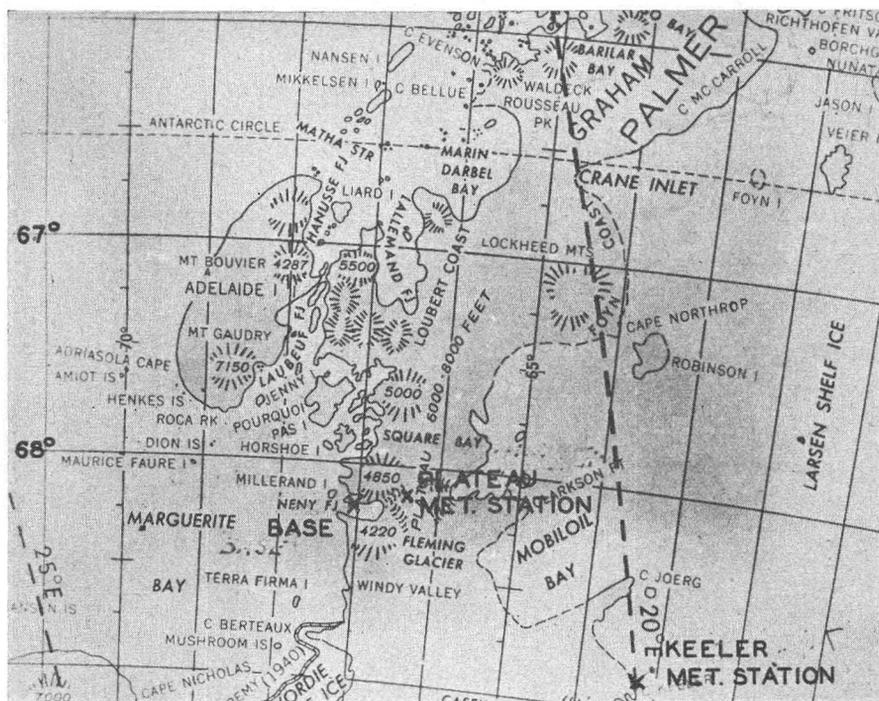
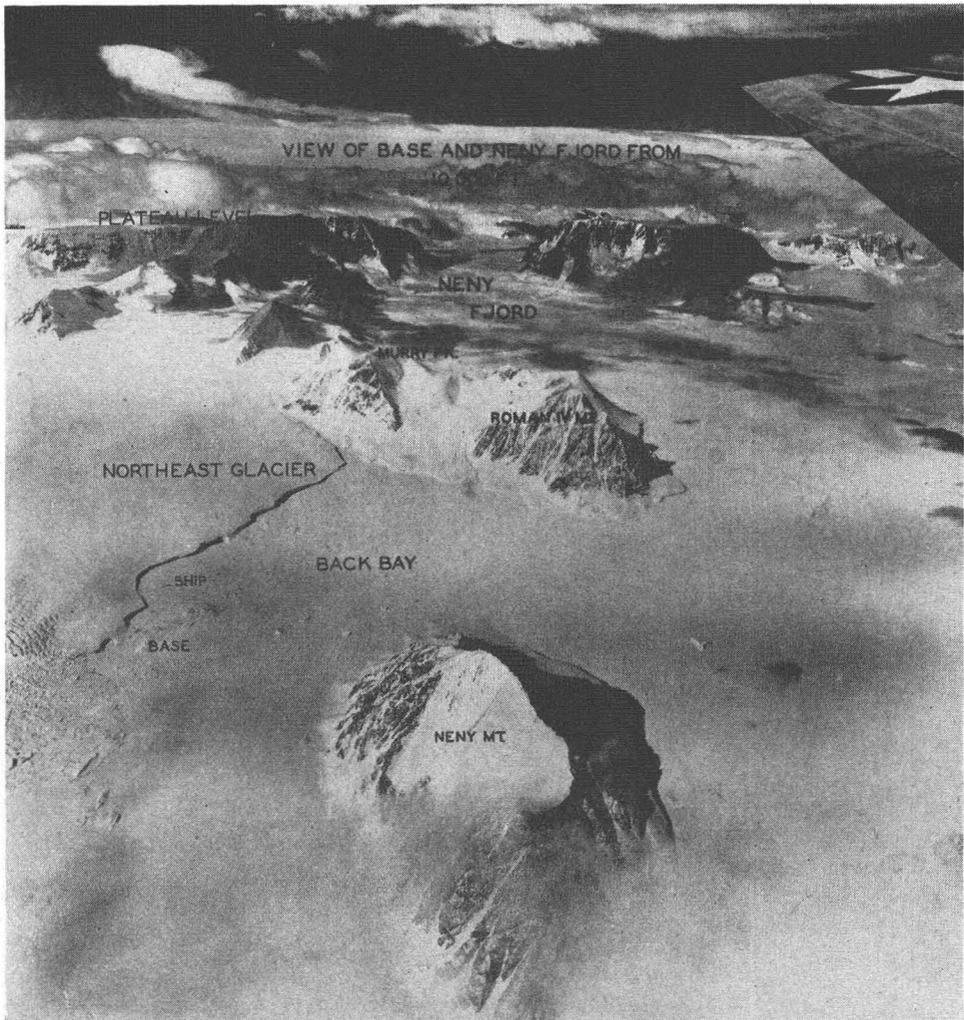


FIG. 12. Map of area in the vicinity of our base. Note, two met. stations.

hours and sixteen minutes at an altitude of about 10,000 feet during the whole trip.

Since the sky was still clear and even though it was 0100 GMT at longitude 62° West, we climbed to 10,000 feet and took photographs for an hour and a half going north, until we ran into low fog. (See Figure No. 18.) We flew along the coast with only the inboard and vertical cameras in operation. The outboard, or right camera would have photographed only shelf ice and bay ice. The low clouds and fog forced us to land near Steele Island, where we spent the night using the emergency equipment that was always in the plane. The next day was clear enough to permit our return to base. The total mileage there and back was approximately 2,500 miles. Photographs were taken at the extremities of the flight only, due to gasoline shortage and other planned flights over the same territory.

Our equipment, facilities and personnel prohibited the processing of all the film, so the three rolls taken with the left oblique camera were developed and only a few of these printed. These would give us a good idea of the country flown over and an indication of the camera performance over a wide range of



light conditions. With our equipment it took about two days to develop and dry one roll of film. Most of the time was spent in the drying process, since no heating unit had been provided with the drum drier. By using an auxiliary squirrel cage drier, the slowest feed, and with occasional stops, the film would be dry by the time it got to the takeup spool.

On November the 27th, Capt. Lassiter and I took off to map the Palmer Peninsula north as far as Crane Inlet. We went south gaining altitude and then came back over base at 10,000 feet, a little inland on the west side of the peninsula. The sky was clear on our side of the plateau but there were clouds on the east side which increased as we went north, until the visibility decreased so much that photographs would be of no value. We turned around and flew south about forty miles inland over the middle of the plateau, past base and further south to a place abreast of the Wordie Shelf Ice. Here we turned to the west and went slightly south of Mt. Edgell, across George VI Sound and Alexander Island at about 70° South latitude. We flew south for a short distance, ran into more ground fog and so turned and flew north again to the head of Alexander Island. We made a long turn around the northern end of the Island, flew down the east side back to Mt. Edgell. We followed the coast back to base, some 60



FIG. 13. C-45 leaving ship in the Antarctic. Note: Ship frozen in bay ice, weasel assisting with the lines.

FIG. 14. Our three planes in front of Base after a storm.

miles west of the flight line of several hours before. The exposures on all three cameras were changed during the trip to compensate for the changes in lighting conditions on the ground. All the cameras appeared to work satisfactorily, however, I found out later that the last magazine on the right oblique camera had not wound correctly for the last few exposures. None of this film was processed. We were in the air for five hours and fifty-five minutes and the cameras were on for five hours.

The next clear day was the third of December. On the flight of November 27th, both Capt. Lassiter and I had tried to locate Charcot Island. We could not see anything in the place indicated on the map. We saw objects on the horizon, but they were much too far away to be the island. Consequently, on this flight, Comdr. Ronne, Capt. Lassiter and I headed south along the coast and down George VI Sound to map that area, the whole of Alexander Island and Charcot Island. Our course was irregular due to low clouds and banks of

fog but by zigzagging we covered all the terrain from 69° to 72° south latitude and from east of the Batterbee Mountains to the west side of Alexander Island including Charcot Island which previously must have been hidden in low clouds. We flew back to Mt. Edgell over the Douglas Range and then to base. Our altitude was 10,000 feet except for a few times when we had to descend to avoid clouds. All of the cameras worked well until near the end of the flight when the cabin got very cold. The interior of the plane was heated but not enough to keep the cameras warm when the sun went down. This flight was about 900 miles. The cameras were operating for 4 hours and 28 minutes. None of the film was processed.

The next day, I extended the partition behind the oblique cameras with a piece of canvas to close off the tail section, and put in a one inch rubber tube leading from the cockpit heater to the after compartment, to try and keep the cameras warmer.

After analyzing the trimetrogon pictures and the extent of our first flight southeasterly, it was revealed that we had not reached the major objective in this sector. Another flight was therefore decided upon. On December 8th the sky was clear on both sides of the plateau early in the morning. Again, both the C-45 mapping plane and the C-64 cargo plane took off for Cape Keeler where they were refueled for the trip south. The right oblique camera, which had given me so much trouble, had gone completely out at the end of the last trip. This was what had blown the fuse. While the others refueled the two planes, I installed the last remaining spare camera which I had previously taken to Keeler for such an emergency. It was lined up only by the previous setting since time did not allow a more accurate job. As at all times, we had to make use of the good weather.

After two hours at Cape Keeler, Comdr. Ronne, Capt. Lassiter and I took off for the south, gaining altitude immediately in order to take pictures on the flight down the coast. The cameras were started at the southern end of Wilkins Island, 27 minutes after takeoff, at an altitude of 8,800 feet, while the plane was still climbing. Two hours later we landed on the bay ice beside the dogteam trail party just off shore from Mt. Tricorn. We topped off the gasoline tanks from the supply in the C-64 and took off again headed south. Unfortunately, after about one hour we ran into heavy low hanging clouds and had to turn back. We landed again beside the trail party where Lt. Adams had remained to guard the flight. We pitched our tent and for dinner, had seal meat, taken from a nearby lead, by the trail party. Here we stayed for three days in zero-zero weather spending most of our time resting in the tent. The trail party had moved on to the south navigation by sledge wheel and compass. They were taking "fixes" for ground control for the aerial photographs and acting as a supporting party should anything happen to the planes.

The morning of December 12th was clear enough to fly, so we took off at eight-thirty after an hour's work freeing the skis which had frozen in the snow. We climbed slowly to save gasoline, so no pictures were taken for one hour and forty minutes. When the cameras were turned on, we were still at only 6,000 feet, however, all this territory had been covered by the flight of November 21st. We flew along shelf ice, a short distance in from the edge, for three hours, to latitude $78^{\circ} 20' S.$, longitude $41^{\circ} 00' W.$, then went due south for half an hour reaching latitude $79^{\circ} 00' S.$, longitude $43^{\circ} 45' W.$, before turning around and heading for Mt. Tricorn where Lt. Adams was waiting for us alone. Co-pilot Schlossbach, his emergency gear, and some gasoline had to be left on the trip down because of poor surface conditions and no wind for takeoff. We did not



FIG. 15. W. R. Latady throwing the American flag out of the C-45 at the southernmost point reached.

FIG. 16. Comdr. Ronne, W. R. Latady, Capt. Lassiter, beside the C-45 after the long southern flights.

land at Mt. Tricorn but stayed at 10,000 feet with the cameras running and radioed Lt. Adams to follow us up the coast. He took off and went directly to Cape Keeler, picked up the personnel and took them all back to the base. We stopped east of Gruening Glacier and fueled with the 130 gallons of gasoline that had been left with a trail party cache, and then flew on to base. On the 2,500 mile flight, photographs were taken for seven hours and fifty-one minutes or for approximately 1,100 miles. The cameras all worked well, except one of the magazines stopped winding the film at the very end of the flight.

The next photographic flight was on the twenty-first of December. We had tried once before to map to the north as far as Crane Inlet but bad weather had prohibited our getting that far. On this flight, Lt. Adams piloted and Capt. Lassited co-piloted, while I took care of the cameras as usual. We flew to Cape Berteaux gaining altitude, then went north over base and across the center of Adelaide Island, past Mikkelsen Island, where the personnel from the East



FIG. 17. New Bedford Inlet. K-17 photograph taken late in the evening on the first flight south. Altitude of the plane, 10,000 feet, height of mountain in center of the picture is 4,100 feet (taken from ground survey).



FIG. 18. Heavy clouds near Steele Island. The cause of our spending a night in the field at the end of our first long flight south.

Base of the United States Antarctic Service Expedition had been evacuated in 1941. Thence latitude $65^{\circ} 30' S.$, before being turned back by fog. We flew down the center of the plateau to the east of the flight track made on November 27th, and returned to base over Neny Fjord. This flight was a short one of only 3 hours and nineteen minutes or about 450 miles with pictures taken for 2 hours and thirty minutes. Again, one of the magazines did not wind at the end of the run; this time a different one. I found out later that it was for the same reason as before.

The sky was still clear on the 22nd of December so we took the opportunity to finish photographing the east side of the peninsula from the south end of Wilkins Island, the northernmost point that had been photographed on that side, north as far as possible. We gained altitude going south until we were over Mt. Edgell at 9,000 feet at which point the cameras were turned on. Our course took us north of Mt. Wakefield to Cape Collier where we turned to follow the coast, heading almost due north. Capt. Lassiter and I were the only ones in the

plane, so with the lighter load we were able to fly at a much higher altitude—about 14,000 for most of the flight. Low clouds and fog were present on the west side of the plateau but the east side was clear except for patches here and there that we encountered on the return journey. We flew north as far as latitude 66° S. and then turned inland and came back paralleling the outgoing flight about ten miles inland. Because of clouds, we had to descend to 10,000 feet and circumvent the Lockheed Mountains. South of the mountains we crossed the plateau, passing over Fleming Glacier, and then down over Neny Fjord to base. That flight was four hours and fifty minutes and the cameras were on for four hours and three minutes. All cameras and accessories worked satisfactorily.

On December 23rd we made our last successful photographic flight. Again we headed south gaining altitude and again I started the cameras when we were abreast of Mt. Edgell. We followed the eastern edge of King George VI Sound around the bend to the westernmost edge of the ice shelf and then continued southwest to approximately latitude 74° S., longitude 80° W., where we landed and Comdr. Ronne took a sun sight with a bubble sextant. The altimeter read 3,100 feet. After just ten minutes we took off and headed northeast, going a little west of our course down. We passed over Ronne Bay, went due north over Alexander Island and then northwest to Charcot Island where we landed and Comdr. Ronne obtained a line of position. The altimeter indicated the island to be 900 feet high at this point. We took off in five minutes and set our course for base. We flew across Alexander Island to Cape Nicholas where we ran into heavy clouds and had to descend to 4,700 feet at the head of George VI Sound. I left the cameras on until we were abreast of Mt. Edgell again, even though our altitude was only 4,350 feet. The clouds lowered so fast that by the time we were at Red Rock Ridge the ceiling was 200 feet. We had a harrowing experience coming around the Ridge just below the clouds in a forty mile an hour wind. The flight was 8 hours and twenty-six minutes, the longest single flight of the season. During this time the cameras were on for five hours and fifty-eight minutes. The cameras had worked perfectly during the whole flight.

The day after Christmas, we attempted one more flight but we were downed fifty miles from camp because of trouble with the left engine. We landed on a glacier than was crossed with crevasses and radioed base for assistance. Our mechanic, James Robertson, was flown out in the L-5 by Lt. Adams to repair the engine. He had it fixed that evening, but fog had set in by then, so we were stuck there until the morning of the 30th when we managed to get back during a break in the weather. The C-45 Beechcraft was taken apart that afternoon and was back aboard the ship the next day. The photographic plane had flown about 100 hours of which a little more than 50% was on photographic flights. The rest of the hours had been used flying caches and personnel.

CONCLUSION

The trimetrogon mapping program started on the 21st of November and was finished on the 23rd of December. Only seven flights had been made, although every available flying day for long flights had been utilized. The longest wait for a break in the weather had been a period of twenty-eight days of snow and overcast when the visibility made it impossible to fly. 13,920 K-17 photographs had been taken over approximately 5,300 flying miles. The average altitude from which these pictures were taken was 10,000 feet although some were exposed from as low as 4,350 feet while others were exposed at 14,000 feet. The reasons for the altitude varying so much were: 1) the shortage of gasoline to gain altitude quickly and make reflights, 2) the limited weather stations to

give local conditions and forecast distant disturbances, and 3) the great overloads that were carried on all of the flights. Although the weather was so often against us, the long summer nights made it possible to photograph twenty out of twenty-four hours.

In photographing the Palmer Peninsula from latitude $65^{\circ} 30' S.$, to latitude $80^{\circ} S.$ and from longitude $38^{\circ} W.$ to longitude $81^{\circ} W.$, we have covered an area of about 250,000 square miles of unexplored territory. We have covered a conservative 450,000 square miles of Antarctic territory considering the area included in the field of the cameras. This latter figure is not limited to the land but includes bay ice, shelf ice and possible islands that may be revealed.

RECOMMENDATIONS

I highly approve of the trimetrogon aerial mapping method for polar exploration and remote areas. I would suggest the following equipment and procedure of operation.

Aeroplane

Although the C-45 Beechcraft gave us good service, I would not recommend it for mapping in the polar regions. I would advocate a high wing, twin engine or tri-motored plane that would cruise at 220 mph or better for a minimum of eight hours, with a ceiling of not less than 15,000 feet. It would have to be equipped with skis, and to get this high speed and long range, it would be well to have them retractable. The plane should be able to carry three men, pilot, navigator, and photographer, with all their emergency equipment to sustain them in the field for a minimum of thirty days. In all mountainous territory and in remote regions, three men are safer than two.

The high wing is necessary to prevent snow from drifting around the plane in a storm. Our C-45 had large drifts around it after a storm when the C-64 was free from snow. Two or more engines are necessary, both as a safety factor (the plane should be able to fly on any one of the motors), and to make the plane more maneuverable when on the ground. Also, the added torque makes it easier to "break" the skis out, when frozen in the snow. If one engine is hard to start, the other may be used to charge the batteries and get it going.

The skies in the Antarctic are seldom clear enough for aerial mapping, so when the weather does permit a flight it is advantageous to make the most of it. Thus, a high speed, long range plane is necessary. The topographic relief is great on the Palmer Peninsula, varying from sea level to plateau level of 6,000 feet, and to the mountains of 13,000 feet, while the polar plateau itself is 10,000 feet high. Consequently, 15,000 feet should be the minimum altitude and I would recommend 20,000 to 25,000 feet if oxygen is available.

The development of retractable skis would be a boon to all polar aviation, since it would increase the mileage obtained from every gallon of gasoline which is so difficult to obtain at any base, and even more precious when transported to a cache.

Our C-45 was painted red and yellow so that it would stand out against the snow, the mountains and the sky. This is a good precaution in a country where everything is white and there are few land marks.

Any aeroplane for polar work should have the usual winterization for cold weather operation, including inertia starters.

Cameras

The K-17 camera with a six inch focal length lens, is a good camera for low

and medium altitude photographic mapping, in the polar regions. Each camera should be equipped with a heating jacket and a separate switch for turning it on and off. There should be a fused line directly from the batteries for the heating jacket and the magazine heaters, and three extra outlets to preheat the next set of magazines. There should be enough loaded magazines on each trip so that it is unnecessary to reload them in the plane. I suggest that a 35 mm. movie camera be installed to automatically record the time, altitude, air speed, and the bearing of the plane at the time of each exposure of the K-17's. The 35 mm. camera could be run by the intervalometer. Such a device would leave the photographer more time to operate the radio altimeter, use the view finder and set the intervalometer, and change magazines. He would also have more time to record other data useful for the final compilation of a map.

Film

The high speed panchromatic film was very satisfactory for our mapping; however, a slower film could be used in the polar regions where there is so much light. Color film might be used exclusively to advantage.

Development

Development may be carried out in the Antarctic as well as in any other place if the proper materials and personnel are available for the job. Carefully melted snow water is excellent for mixing chemicals and rinsing negatives.

APPENDIX A—PHOTOGRAPHIC DATA

Film

All film used was Eastman Kodak, Super XX Aero Film in nine and one half inch by two hundred foot rolls. The spools supplied in the magazines were for one hundred foot rolls so that five large spools had to be procured from new film.

Exposure

The usual standards of exposures are upset in the polar regions so that exposure guides are of no use. Most of the pictures were taken at 1/300 of a second at f 16; however, some of the late evening photographs were taken at 1/100 at f 6.3, the slowest shutter speed and widest opening possible with the K-17 camera.

Filter

All exposures were made with a number 2 Aero vignetted filter through a $\frac{3}{4}$ inch thick glass window. These windows were optically flat glass procured for the job by the USAF. The heating wires on the filters were not used. Blowers were not used on the windows, and they never frosted up.

Development

Only four rolls of film were developed because of lack of time. These rolls were developed in USAF type C Medium Developer for 22 minutes at 70°F. in a B-5 Developing Kit and dried in a combination A-5 Drying Kit and squirrel cage. (See Figure No. 12.) Sixty-two rolls of film have been brought back for processing in the United States.