NEW DEVELOPMENTS FOR AERIAL RECONNAISSANCE

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I WISH that I had been able to devote as much time to photogrammetry during the past fifteen years as was possible in the first twenty years of my military service. The reason for this was due to the urgent need, during this period, for the development of reconnaissance equipment for tactical and strategic Air Force operations. Throughout this time, however, I gave the fullest support possible to advancement of aeronautical charting and mapping, and as long as I am in the Service, I shall continue to give this support.

It has been my feeling, and I believe it expresses the opinion of the Chief of Staff of the United States Air Force and his staff, that the Air Force is most fortunate in having the photogrammetric industry as a reserve in time of an emergency. This industry, together with the existing Air Force specialized aeronautical mapping units, the Corps of Engineers, the Navy, the Geological Survey, and the Coast and Geodetic Survey, is a well-equipped reserve of trained personnel, techniques and equipment to meet the mapping needs of the United States in time of an emergency.

It is for this reason that I have devoted the greater part of my time during the past fifteen years to the development of night and day aerial reconnaissance equipment and techniques. Unfortunately, there is no reserve of personnel or facilities to meet these requirements other than those of the Air Force and Navy. As the Air Force is expanded and the requirements become more complex with the development of high-speed and long range aircraft, the Wright-Patterson AFB Photographic Laboratory encounters extremely difficult problems.

Intelligence reconnaissance for our Military Forces is constantly gaining in importance and is at present given high priority. The aerial photographic operational phase of intelligence in the Korean War has been of the greatest value and has opened up many new plans for future development.

The Communist attack on South Korea started on June 25, 1950. The United Nations’ counter action in Korea started a few days thereafter. In early July, upon orders of the Chief of Staff, United States Air Force, I left for Korea for the purpose of studying reconnaissance problems, evaluating new and novel problems, and introducing some new equipment to the reconnaissance units.

Together with my associates, we fitted out a special C-54 airplane at Wright-Patterson A.F.B. and took overseas a load of fresh black-and-white, color, and camouflage detection films, which at that time were sadly needed by the photographic activities. This picture at the upper left of Figure 1 shows our plane with the personnel and photographic materials en route over the Pacific. That at the upper right shows the plane at the Air Force’s 8th Tactical Reconnaissance Group operational base at Itazuke, Japan. This is the nearest Air Force base to Korea—approximately 140 miles from Pusan. It will be noted in the upper right-hand picture that the RF-80 jet aircraft is equipped with auxiliary fuel

NOTE: Col. Goddard was one of the speakers at the 1951 Annual Meeting. His presentation was greatly appreciated by all. It was our desire to print the paper in the March or June Issues but this was impossible because of illnesses and the difficulties in substituting photos for slides. That it is now possible to present the major portion of the original presentation is because of the assistance of Anthony Keogh (technical writer) and Eldon Sewell at Wright Field. Some change in the order of presentation was made necessary by one space needed for the illustrations.—Publications Committee.

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tanks on the wings for long range reconnaissance over the Northern part of Korea. In the lower pictures, the mechanics under the supervision of M/Sgt. Branscomb are shown installing the latest standard S-11 twin-lens continuous strip camera in the RF-80 together with the new type electronic scanner. As a result of the operations in Korea, this camera has now been standardized and is in production.
Figure 2 is a schematic drawing showing the entire equipment. Notice the operational relationship between the scanner, the master control panel and servo power unit which feeds correct image speed information into the camera. Not shown in this schematic diagram is an automatic diaphragm control which constantly corrects diaphragm setting for optimum exposure. This feature is very important for black-and-white but is absolutely necessary for color and relieves the pilot, who in a single-place jet fighter is a very busy individual, from the necessity of making exposure calculations and corrections.

To demonstrate the practicability of this equipment, the first mission over the enemy rail and highway supply lines was flown by a pilot inexperienced in the use of this camera. He flew the first stereoscopic vertical mission at an altitude of 900 feet and a speed of 500 miles an hour, 15 minutes after the sun had set. (See Figure 4.) This is an area approximately 50 miles northwest of Taegu and was flown in the latter part of July 1950.

Continuous strip photographs like that in Figure 3 were of tremendous value in the intelligence work preceding the mid-September invasion at Inchon. In the foreground is shown the exact character of Blue Beach. The use of this type of photography was described in detail by Mr. Amrom Katz in the March 1951 issue.\(^1\) It is interesting to note that changes in elevation of the terrain had little effect on definition in the picture. This is brought about through the use of a very narrow slit opening, which is essentially high shutter speed. These pictures could well have been made with this equipment in a jet aircraft flying at 1,500 miles per hour, where a shutter-type conventional camera would have been useless.

\(^1\) **PHOTOGRAMMETRIC ENGINEERING**, Vol. XVII, No. 1.
As this camera was further demonstrated to the Ground Forces in Korea, the paratroop units were much impressed with the possibility of using this type of low-altitude third-dimensional oblique photography as a briefing means prior to paratroop operations. Figure 5 shows a successful drop of paratroops and supplies made after such a briefing.

The C-1A Sonne Printer proved of tremendous value and was demonstrated to be a great time saver in the laboratory operations, where 40 feet of film could be printed in one minute. It further saved time in the handling of individual prints, both in intelligence interpretation and orientation on a map, and in distribution and filing. The paper rolls from the C-1A Printer are processed in the same machines used for processing aerial roll film.

It has been found that under extremely bumpy air conditions it is necessary to have the strip cameras mounted in stabilized mounts, which correct for roll only. Figure 6 shows at the left the later type which is now under development in the Photographic Laboratory. The picture at the right was taken during extreme air turbulence, without stabilization.

The combination of the stabilized mount, electronic scanner, and the photocell light control, has given exceptionally good results over special test targets in California, at speeds of 500 miles an hour. A considerable number of flights have been made in connection with the Bill Jack Scientific Instrument Company research and development program. Also, in late tests of the strip camera, we have been using the San Diego area to check synchronization over circular tanks, which gives us good data on synchronization. Other color pictures flown clearly demonstrate the value of the strip camera equipment in terrain studies made during the Bill Jack tests.

S-11 strip photos taken at different altitudes are shown in Figure 7. Reading from left to right, the pictures were taken at 200 feet, 400 feet, 800 feet, and
The S-8 Strip Camera made by Chicago Aerial Surveys Company is shown in Figure 9. The use of cassettes has some advantages. However, they do increase the height of the camera, which makes its installation impossible in certain reconnaissance aircraft. This camera is undergoing further tests with a new type scanner which may have excellent possibilities.

1,500 feet, showing the high efficiency of the automatic synchronization system.

Figure 8 is a reduction from an enlarged continuous strip picture of an RB-45 4-jet airplane on the ground. This picture was taken from an alti-

tude of 75 feet, at 500 miles an hour. The original actually shows the individual rivets in the upper surface of the wing.
Another S-11 strip camera picture taken from a "kibitzing" plane shows an Air Force officer in a resolution test on the runway at Wright-Patterson. This picture (Figure 10) was taken at 500 miles an hour at 50 feet. The original photograph clearly shows the four aces on the cards.

Back to Korea and a few illustrations of night photographic operations. In my last lecture at a Society meeting, I explained the new low-altitude high-speed cartridge ejection system of night photography. In this system the airplane flying at high speed ejects cartridges at the rate of 1 every 2 seconds; each short duration flash actuating the camera, which takes overlapping pictures. We had a good opportunity to use this equipment in Korea. In fact, a special squadron has been trained and equipped and has been obtaining remarkable and valuable night photographs. Figure 11 is a typical night photograph which was taken on the 25th of September as we advanced north of Seoul. This photograph, taken with the night system, shows the enemy constructing a new highway to cross the river.
The first installation of the night photo cameras was hurriedly constructed, and it was noted that considerable improvement could be made in vibration elimination. This was accomplished in the theatre. Figure 12 illustrates the improvement as shown by flying over lights with an open shutter. This is a standard method of testing Air Force cameras in vibration tests. The upper picture was taken under turbulent air conditions.
Another night photograph (Figure 13) shows the North Korean machine gun emplacements in rice paddies in a valley on the northeast coast of Korea.

The picture in Figure 14 is one of two remarkable photographs taken in Korea, which thoroughly demonstrates the great value of night photography. This was made on the 8th of December showing North Korean tanks moving down a highway near the Manchurian border. The tank lights were on in the first picture; as the drivers noticed the flashes, the tank lights were turned off—all except one, as shown by the arrow in this picture. These pictures were taken at 11:00 o'clock at night, processed and delivered to the fighter organizations early the next morning, and it was reported that all of these vehicles were destroyed.

In the further development of cartridge flash photography, it has been necessary to increase the number of cartridges being carried. A later installation in the RB-45 carries a capacity of 200 cartridges. Further developments in night photography are constantly under way.
The standard Air Force equipment used for high-altitude flash bomb photography is the Fairchild K-37 Camera (Figure 15) which very shortly will be changed to the K-47. This camera will be equipped with a more efficient shutter which will permit more effective utilization of the bomb light.

One of the contributing factors to improvement in night photography has been the employment of the A-14 Moving Film Magazine. This magazine (Figure 16) is equipped for day and night operations, and is proving of great value in improving the definition of all aerial photographs.
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FIG. 16
In the laboratory, Wright-Patterson AFB is constantly working to increase the altitude of night photography. The picture (Figure 17) was taken near Las Vegas from a very high altitude using one of our latest flash bombs. The improvement in flash powder by Wesleyan University and the U. S. Army Ordnance has aided this development materially.

Getting back to Korea, I have combined in Figure 18 a series of daytime strategic bombing photographs. These were made with the standard Fairchild K-18 and K-38 Cameras mounted in the rear of the bombing airplane. Since the last war, the strategic bombing commanders insist on taking 9×18 inch large-scale bombing recording photographs and are quite willing to accept the additional weight and size in order to obtain the maximum picture results.
During our work in Korea, we had the opportunity of demonstrating the transmission of photographs by radio from aircraft. There is still a great deal of work to be done on this development, but it does look favorable at this time. The picture (Figure 19) taken over Cincinnati, was processed in the air, and transmitted to our Laboratory in 14 minutes. The Land process affords a quick method of obtaining the film transparency which, when transmitted, can be received as a 9×9 inch positive or negative. Land pictures will be standard within the near future for picture transmission work.

Photography is one of the main sources of intelligence in Korea; the photograph (Figure 20) shows part of the film library of the main photographic unit in Japan. It is clear that aerial reconnaissance is not only important, but is also a very large activity.

Space does not permit adequate treatment of all the recent advances in mapping lenses, mapping cameras, mapping mounts, and other techniques of mapping and charting. The Society will be interested to know that a new mapping camera, the T-11, is now in production by the Fairchild Camera & Instrument Corporation, and incorporates perhaps the outstanding development in mapping camera shutters in the last 30 years. This shutter (illustrated in Figure
FIG. 20

FIG. 21

21) was invented by Mr. Fred Willcox, a Washingtonian. The improved American version of the "distortionless" Topogon V lens, developed by the Bausch & Lomb Optical Company, will be put into production and undoubtedly will go into all future mapping cameras. All these things require separate and detailed papers for presentation to the Society, and such papers will be presented in the near future.