You don't necessarily have to be flying in the Swiss Alps to get beautiful pictures like this. It illustrates the value of proper framing of your shots. (This photograph was taken near the Matterhorn.)

Color illustrations courtesy of Eastman Kodak Company

Aerial Photography For Private Pilots

by ALBERT A. MARKS, III / AOPA 293514

You can take good pictures from your plane in flight if you follow certain basic rules. This article tells you how to do it

EDITOR'S NOTE: *Many pilots carry cameras along with them when they are in the air, but quite often the results indicate they need a little proficiency training in the photographic department. In our search for a "down-to-earth" article on aerial photography for private pilots, we were fortunate in enlisting the aid of Eastman Kodak Company. The author, Albert Marks, is a member of Kodak's Editorial Service Bureau at Rochester, N.Y. What's more, he's a pilot of two-years' standing and a member of AOPA. He worked closely on technical details with Kodak staff photographers. This is Marks' first contribution to The PILOT. The striking illustrations used with this article were supplied by Eastman Kodak.*

■■ Aerial photography had its beginnings long before Orville and Wilbur Wright's momentous achievement at Kitty Hawk on Dec. 17, 1903. In fact, in December 1858, 45 years earlier, a Frenchman, Nadar, took the first aerial pictures from a balloon. His methods not only called for trial and error, but his materials were usable for less than 20 minutes—which meant the film had to be sensitized, exposed from the balloon, and processed all in this short period of time.

Just as our nineteenth century French aviator would probably find it much easier to fly one of today's planes with an autopilot, he'd find it much easier to take his pictures with a well-instrumented, almost automatic camera. The instant-loading or automatic camera you use for Christmas and vacation pictures is just as much at home in the air—and will probably give you far better pictures than you would guess.

Granted, you probably don't earn your living as an aerial photographer—you fly for fun. But why not try some of these hints to make your aerial photographs as rewarding and as much fun as the leisure time pictures you take on the ground?

Rough air and plane vibration are often serious challenges to taking clear, sharp pictures. Try to get your pictures in the morning before the ground heats up and causes thermals. If ground fog is prevalent, as is often the case in summer months, take your pictures in the evening hours after the heat of the day has passed—colors will be warmer, too.

Vibration causes blurry pictures. Don't rest the camera or your elbows on any part of the plane or helicopter in order "to steady yourself." Your body will absorb much of the vibration if you hold the camera firmly, your elbows away from your sides. The remaining blur can be almost totally eliminated by using an increased shutter speed with a proportionately larger lens aperture.

Reflection can be another serious problem to the unwary. Get the camera as close to the window as possible without actually touching it. If your camera

is not a single lens reflex (through the lens viewing), avoid parallax mistakes caused when your viewfinder and lens don't "see" a nearby object at the same angle. Parallax corrections should, however, be necessary only when you are including a part of the wing in your picture.

Haze is something you can't always avoid in aerial photography. Almost always present, haze creates a bluish cast in color photographs and lowers the contrast in black and white films. The bluish veil is the result of smoke, dust, and water particles present in the air which scatter the light rays. To help minimize the effects of haze, a polarizing or skylight filter is available for daylight-type color films. If you use the polarizing filter, be sure to increase your exposure by two full stops to allow for the decrease in light reaching the film. For black and white films, a yellow filter (Kodak No. 15G) will restore normal contrast when you open your lens by at least a full stop.

SHADOWS FOR CONTRAST—Whenever possible, use light to your advantage. Shadows are your only clue to terrain contour and object heights. Sidelighting will emphasize your subject, making it stand out from its surroundings. Where practical, avoid backlighting because of the bluish veil of haze that appears from this angle. In the summer most of your black and white pictures can be made during all daylight hours except when the sun is at its zenith (11 a.m. to 1 p.m.). With the exception of the noon hours, shadows on the ground are long enough to enhance the contrast which is so important in black and white photography. In the winter, the low angle of the sun provides effective shadows all day long.

One of those rare days, when there is no smoke or haze, it is possible to get a crisp and clear picture from a plane. This is an aerial view of Chicago's seven bridges.

When you are taking a relatively close-up shot from your plane—such as a picture of the Statue of Liberty, for instance—sideslip or bank the plane to reduce the apparent motion.

Color photography is not as seriously hampered by shadow contrast as is black and white. For the most part, color provides its own balance. At high altitudes, however, the haze will probably cause insufficient contrast except on the very rare 15+ days. For the most authentic color balance, color films should be exposed from an hour after sunrise to an hour before sunset.

CHOICE OF FILMS—For most black and white aerial photography a film such as *Kodak Plus-X Pan* or *Verichrome Pan* film will do a good job. Because of their fine grain and speed, these films are especially suitable for most amateur aerial shots.

For color aerial pictures, best results are obtained from a high-speed negative-type film. *Kodacolor-X* and *Ektacolor* films are suitable for this purpose. These negative films are recommended for situations where exposure settings are uncertain or cannot be predicted accurately. If you can obtain an accurate meter reading, *Kodachrome II* and High Speed *Ektachrome* are useful transparency films, depending on the lighting. But if there is any doubt in your mind, use the negative films. They can always be made into slides later.

SLOWEST RECOMMENDED SHUTTER SPEEDS

ALTITUDE IN FEET	GROUND SPEED IN MILES PER HOUR						
	75	100	150	200	250	300	350
4000+	—	1/50	1/50	1/100	1/100	1/200	1/200
3000	—	1/50	1/100	1/100	1/100	1/200	1/400
2000	—	1/100	1/100	1/200	1/200	1/400	1/400
1000	—	1/200	1/250	1/400	1/400	1/500	1/500
500	1/250	1/400	1/400	1/500	1/500	1/1000	1/1000
on the ground	1/500	1/500	—	—	—	—	—

If you prefer more dramatic pictures, try black and white or color infrared films. These films can add interesting variety to your pictures and are a lot of fun to experiment with. For particular use and special applications, be sure to read the instruction sheet packed with infrared film.

IN-FLIGHT CHECK LIST—Here's a simple check list. Once the film is exposed, there is no turning back, so be sure your camera is properly set and adjusted.

FOCUS—Focusing is simple. For most aerial photos, you can set the lens at infinity and leave it there. If, however, you wish to include part of your wing in the picture, be sure that your aperture is small enough for a proper depth of field. In order to do this, you should use a higher speed film such as *Kodak Tri-X* or High Speed *Ektachrome* to allow for a sufficient

This is how Niagara Falls can look in an aerial photograph.

shutter speed. Set the lens focus for about 25 feet. At this distance with an f-stop of f/16, you should get a clear picture for any distance from ten feet to infinity.

SHUTTER SPEED—The easy-to-use instant-loading cameras have a fixed shutter speed, e.g., about 1/90th of a second. This speed will be adequate under most conditions if proper precautions are taken against camera movements. If you are using an adjustable camera, a shutter speed of 1/125 or 1/250, depending on the speed of the film, will be adequate with a ground speed up to 120 miles per hour at altitudes over 1,000 feet. At relatively close range, or with a telephoto lens, a faster shutter speed is required. Remember, too, a telephoto lens not only magnifies your picture, but also magnifies every jiggle of the camera! For detailed information on shutter speed, refer to Table 1 on page 39.

EXPOSURE—In taking low altitude shots of buildings, construction, ships, industrial centers, etc., the exposure setting will be the same as that on the ground under similar conditions. Low and medium oblique altitude shots of green foliage and dark soil may require an exposure increase of one stop, particularly for color transparencies. To increase one full stop would be, say f/8 to f/5.6 or f/16 to f/11, rather than f/8 to f/7 or f/16 to f/15. High oblique shots usually require one stop less than for pictures of sunlighted subjects on the ground.

Why not put faith in the direct exposure meter reading from the air? Most exposure meters are designed to automatically compensate for a certain percentage of shadowed areas. With the fairly uniform exposure field you have in the air, these percentages do not hold and you will get an inaccurate meter reading. Haze, too, can give a reading which could result in underexposure. Where does this leave us? To find out how your meter reads on your first roll of film, you might shoot a half-dozen pictures according to your meter reading. For the rest of the roll shoot three pictures, each of the same scene. Shoot the first according to your meter reading, the second one stop *greater* than your reading, and a third one stop *less* than your reading. Don't change your focus or shutter speed, but vary the aperture opening. As you compare the finished pictures, your experience will pay large dividends every time you take an aerial picture.

WHAT TO SHOOT—Shadows are

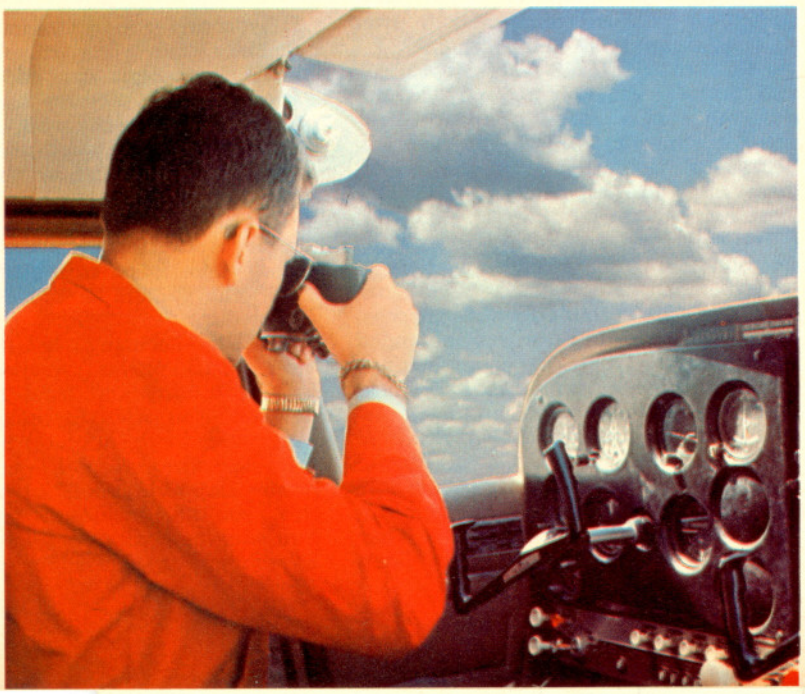
A GUIDE FOR BASIC AERIAL EXPOSURES

Scenes in Bright Sunlight*	**Kodacolor-X** Film ASA 80	**Kodak** High Speed **Ektachrome** Film Daylight Type ASA 160	**Kodachrome II** Film ASA 25	**Kodak Tri-X** Film ASA 400	**Kodak Plus-X** Pan Film ASA 125
Average scenes with houses, trees, fields; winter scenes without snow. No important shadows.	1/125 sec. f/11 ‡	1/250 sec. f/16 ‡	1/125 sec. f/8	1/250 sec. f/22	1/125 sec. f/16
Bright scenes—deserts, beaches; also, high obliques, including horizon.	1/125 sec. f/16 ‡	1/250 sec. f/16 - f/22	1/125 sec. f/11	1/250 sec. f/32	1/125 sec. f/22
Clouds photographed "on top"	1/125 sec. f/11 - f/16	1/250 sec. f/22	1/125 sec. f/11 - f/16	1/500 sec. f/22	1/250 sec. f/22

* For hazy days, double the exposure; for cloudy days (completely overcast), quadruple it.

‡ Decrease the lens opening with increasing altitudes: Below 1000 ft., same as for average ground subjects; 1000-2000 ft., ⅓ stop smaller than for ground subjects; 2000-4000 ft., ½ stop smaller than for ground subjects; and 4000 ft. and up, 1 stop smaller than for ground subjects.

NOTE: First determine the necessary shutter speed from the table of Shutter Speeds; then calculate the equivalent exposure from the above table.



Author Marks demonstrates in-flight technique which he has found most adequate for eliminating the effects of vibration and motion caused by the plane.

helpful in providing good contrast. In the mountain picture, at bottom of this page, the shadow in the right foreground offsets the haze in the left rear. There is just enough contrast to convey the feeling of the awesome height of the mountains high above the timber line.

If the camera angle had been any less, there would be very little of the grandeur of the scene because the picture would be lost in the distant haze.

But there are times when you are flying when shadowed areas are at a minimum. To add contrast you might include a body of water, which offers color-balanced contrast. The icy blues of the water offset the imposing grays of the mountain. Shots of water invariably give variety as well as contrast to your pictures.

FRAMING—Framing shots also adds variety to your pictures. You don't necessarily have to be in the Swiss Alps to get a picture like the one showing the ski-equipped plane over the Alps. Scenes, framed as this one is, can be taken anywhere in the world. The wing of the photographer's plane contributes to the composition.

Sunsets are also a beautiful source of color pictures. No two are ever the same. You might want to try your pictures with or without a skylight filter to give different impressions of the same scene.

One last thing to remember in aerial photography: try to tell a story with your pictures. If you are on vacation, you will want to get a picture of yourself at the weather briefing station, the walk-around, the preflight cockpit check. Before takeoff, a passenger can get a picture of you getting taxi or takeoff clearance. As you are rolling down the runway, a straight-ahead shot launches your viewer right into the sky with you. Obviously you will be taking pictures of the beautiful fields, rivers, and prominent landmarks along the way. If possible, get some shots of landmarkers with the names of the towns you are passing to note the trip's progress. Refueling and shots of a strange airport can also be interesting.

If your trip takes you out of the country, get pictures of the attendants where you land against the local terrain or a sign in their language if different from yours. Take shots of the city of your final destination as you are landing and, finally, as you are registering your plane at flight operations.

When the trip home begins, and if you have time, fly over the place where you stayed and take a picture to complete the story of this leg of the trip. You will expand these ideas with your own imagination and ingenuity and probably surprise yourself at how creative you can be in telling a story of this sort.

It is surprising what you can do with pictures. Next time you take your family up on a Sunday afternoon, try taking a few shots and see what you can do. Flying affords endless picture-taking opportunities, so whatever you do, be sure to take along plenty of film; better to have too much than too little. □

Prominent landmark, such as this lighthouse at Vancouver, B.C., makes a good title scene to the picture story you bring home from your vacation.

Whether on the ground or in the air, composition is important. In this photograph, the airplane adds considerable appeal to the Tasman Glacier scene.

When possible, use shadows in order to reduce monotonous haze. They also add contrast and variety to your pictures. (Check list, "What to Shoot" in accompanying article.)