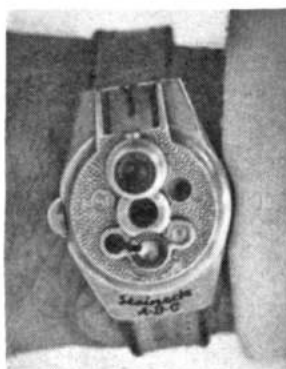


...the past...

By JOSEPH D. COOPER

Subminiature devotee and specialist Joe Cooper presents, in the next ten pages, a roundup discussion of the pocket-size camera—its origins, where it stands today, and what's to come; plus a directory of the current subminiature market; a look at film and accessory availability; shooting tips; and information about processing. Cooper is the author of The New Ultra-Miniature Photography, Universal Photo Books, \$3.95; and the Universal guides to Minox, Minolta-16, and Mamiya-16 cameras. In addition, it's probable he owns one of the world's most complete collections of subminiature cameras. The two shown below, among the earliest efforts at subminiaturization, illustrate attempts at concealment. Both are disguised to resemble timepieces. Top is the Expo "pocket watch," and bottom is the wrist-strapped Steineck A-B-C camera.



Although size and weight (or lack thereof) are the major considerations behind the current boom in subminiature cameras, there's little doubt that the first of these was inspired by an interest in concealment. At first, concealment was accomplished by disguise. Almost from the moment that dry plates became a practical reality, efforts were made to hide cameras in the interests of truly candid photography. By the 1880s there were quite a few so-called "detective" (because they were disguised) cameras on the market. They weren't necessarily small, in our terms, nor did they look much like cameras. One looked like a paper-wrapped package of about shoe-box size with a hole in the end; one of the very successful models, the Fallowfield Facile Detective Camera was built into a suitcase; and the Eastman Dry Plate & Film Co. introduced a small ($3\frac{1}{4} \times 3\frac{3}{4} \times 6\frac{1}{2}$ in.), lightweight (2 lb, 3 oz) detective camera called The Kodak that looked substantially like a box, if only because it had no viewfinder.

The first of the successful pocket-size cameras hit the market at about the turn of the century. It resembled a railroadman's pocket watch. The lens was built into the stem. Behind it was a simple rotary shutter, and it made 14x25-mm pictures on 16-mm film. The watch camera was called Expo in the U.S., while an identical model was sold in England under the name Ticka.

In the next decade there was a rash of subminiaturization, with cameras being built into walking sticks, hats, etc. One detective-type camera was concealed in a false shirt front with permanently attached cravat, and the photographer released the shutter by squeezing a rubber bulb in his pocket, attached by air hose to the camera.

Attempts to refine surreptitious picture-taking equipment continued through the 1930s. Several fine-quality precision cameras were introduced, but then vanished from the market because of the relative shortage of spies, at whom marketing efforts were largely directed.

In 1938 a Latvian inventor, Walter Zapp, came out with a camera that wore no outer disguise, but was quite concealable because of its very small size, about that of a large pocket knife. He called it the Minox, and designed it to take 9.5-mm film, a popular home-movie size in Europe.

Zapp's Minox coincided with the great increase of espionage activity that accompanied World War II, and his camera was used to advantage by both sides.

When the war ended Zapp was hired by a newly organized corporation in Wetzlar, West Germany, to help design a sophisticated, high-quality version of his little camera. The company, which called itself Minox GmbH (and later moved to Giessen), suspected that there was a broad general market for a subminiature camera.

It turned out they were right.

Meanwhile, in Japan, where the war's end was followed by a bursting forth of a bustling camera industry, there was high priority given to developing subminiatures for the popular market. One of the first of these, the Echo 8, a subminiature built into a cigarette lighter, was an improved version of one used by Japanese naval intelligence. Subse-

quent production included cheap novelty cameras, crude scaled-down versions of the 35-mm type, and several top-quality subminiatures that advanced the development of the field substantially.

An interesting sidelight is that one company, the Riken Camera Co., originated as a subminiature manufacturer. Its first product, about the size of a 25-cent piece, using disks of film, was replaced by the Steky, which enjoyed a wide popularity in the U.S. for a time. Next it came out with the Golden Ricoh-16, which is no longer made. The company prospers, however, with several lines of 35-mm and twin-lens reflex cameras.

The Minolta 16 camera line originated as the Konan-16. Today, there are three models of the Minolta-16 on the market; and there is in Japan a Konan Camera Co. that's currently engaged in independently designing new subminiatures. Recently, the Russians came out with a copy of the Minolta-16 II.

For a time there was a penchant for building subminiature cameras into binoculars. This goes back to the 19th century, but was revived in Japan, in the Teleca and the Binoca.

More recently, a binocular camera of top quality was made by the J. D. Moeller Optical Co. of Germany, under the name CamBincox. A precision camera was suspended between the viewing sections of a roof-prism binocular. But sales were so limited, that this camera, too, was dropped from the market.

In the United States, comparatively few subminiature cameras followed the Expo. There were the Universal Minute 16, Whittaker Micro-16, and Tynar. At one time, the Parker Pen Co. had a new camera just about ready for distribution, but abandoned the effort because of the non-standard film format.

...the present...

In discussing the status of the subminiature camera today, I keep hearing it mentioned that it is, or may be, the camera of the future. The fact is that there are hundreds of thousands of subminiature cameras owned and used in this country, not to mention the untold number in use in the rest of the world.

Essentially, the subminiature today is considered a snapshot camera, and most of the people who own them use them as such.

In considering the pros and cons of subminiatures we often hear reference to the quality found in an 8x10 print, shot with a submin and regular film under ordinary circumstances. It is true that the quality of such a print will not, most of the time, measure up to the quality of a print from a negative made with a larger camera, all other things being equal.

But consider this. How big do you think most pictures are printed, whether from subminiature, roll-film, or 35-mm cameras? If they are processed through any commercial

photofinishing service, not more than one in a thousand is printed larger than 3½x5 in. When you consider this, you can see why hundreds of thousands of subminiature camera owners are satisfied, if not happy, with the results they get from their pocket-size cameras. They get prints of satisfactory snapshot quality, which is all they want in the first place, and they have the additional convenience of being able to carry their snapshot cameras especially conveniently.

Why, then, hasn't the subminiature camera yet earned its due respect?

The reasons are several. In the first place, the cameras got off to a false start. Some were originally developed as spy cameras, for actual cloak-and-dagger use. The "spy camera" label has hung on to some extent, and, with it has come an abundant use of gravel-grain films (for sneaky available-light exposures), such as Kodak's otherwise fine Tri-X. Inevitably, those who think their subminiatures are for taking pictures under beds or in dimly lit cabarets are disappointed.

I've talked to distributors, asking them why they sell the grainier fast films for subminiature use, and they explain that they are merely satisfying an actual demand, pointing to the great amount sold. "Nevertheless," they say, "we urge the use of the slower, fine-grain films." This seems rather shortsighted since the inevitably poor results with fast films are blamed on the cameras, even though some of them have lenses whose resolving power is greater than that of any of the films ordinarily available for amateur use.

Another source of the bad image has been the practice of making and selling novelty and toy cameras in subminiature formats. These gadgets, with lenses made from window glass, sell for as little as 41 cents—case and film extra. Other cheap cameras have been built into cigarette lighters (although there also are some good ones), ladies' compacts, and novelty opera glasses.

Probably the biggest offenders have been photofinishers, with the exception of a few who specialize in subminiature processing. You simply cannot dunk subminiature films into the same baths as their giant 35-mm and roll-film cousins. They cannot be handled at work tables and enlargers as though they were loaves of bread being wrapped. They demand a little extra care at each step, care which some photofinishers have not been willing to give. So here, too, is a source of disappointment for the new subminiature fan who can become easily discouraged into leaving his camera in the bureau drawer, or selling it cheap.

A third deterrent has been the lack of standard films. If you have a 35-mm camera you know that you can find film for it in any camera shop, drugstore, department store, or supermarket. The brands and types of film may vary, but the film loads all fit into 35-mm cameras. Not so with subminiatures. *Until this year there were no two cameras that could use films interchangeably.* All the manufacturers were in favor of reaching a standard, but each wanted the others to adopt his own.

This obstacle has now been overcome with agreements

on standards in both Germany and Japan. Two new cameras shown at *photokina* in Cologne, Germany, last March both used the new German standard—a smaller version of the standard 35-mm film cartridge. These are the Rollei 16 and the Edixa 16. Rumors abound of others to follow. But that's another story. The new German cartridge uses 16-mm movie film with perforations on one edge only. The image format is 12x17-mm.

From Japan I obtained a report, now confirmed, that the industry there has agreed to a new twin cartridge which combines the features of the present Mamiya-16 and Minolta-16 cartridges. (Users and new buyers of the present cameras need not be concerned, for film will continue to be available for their cameras.) A twin cartridge has a supply cup at one end in which the unexposed film is stored. At the other end, connected by a bridge, is a take-up cup, into which the film advances after each exposure. The Japanese standard calls for unperforated film and an image format of 12x18-mm.

It appears, unfortunately, that efforts to reach an international agreement on standards have been unsuccessful. On the other hand, two standards are better than none at all, in a jungle which heretofore has discouraged camera dealers from stocking subminiature films.

...the future...

What about the future? I predict that one day subminiature cameras will be the biggest thing in amateur photography, and there are those who are willing to stick their necks all the way out and say the subminiature will someday have the status 35-mm enjoys today among professionals.

Although the current trend is to add features that tend to increase camera size beyond what might be considered ideal, even the biggest subminiatures cannot be considered unwieldy or too big to carry in pocket or purse. I can't help feeling that industry's success in the past decade in miniaturization of almost all things photographic (exposure meters, flash and electronic flash equipment, automatic electric-eye systems and circuitry, etc.) will start reversing the trend of the growing subminiature, and that someday we'll achieve the completely surreptitious wrist-watch or button-hole (or whatever your particular fancy happens to be) camera.

But to get back to the immediate future, I think I could predict without qualm that the next two or three years will see quite a few new subminiature cameras appearing on the market. These new ones, we can feel fairly confident, will adopt either the Japanese or German standard film cartridge.

In addition, we may have independent makes of new cameras, made in Japan, built around the Minox film cartridge, which uses 9.5-mm unperforated film with an image size of 8x11-mm. While new cameras using Minox film are probably about two years away, they could come sooner.

There is a possibility, also, that the once-popular Minicord, previously made by Goerz in Austria, will be made again, in Japan, under license, with built-in exposure meter.

The new cameras to come will be in all price ranges, to meet the widest markets as well as to satisfy the most exacting precision requirements, as reflected in the top-quality workmanship of the new Rollei 16. Advanced designs may be introduced.

One of the remaining obstacles is to get the major film manufacturers to package their films for these cameras. At present, each camera maker must arrange independently to have film spooled and packaged for his camera.

I asked the Eastman Kodak Co. for its position on the future of 16-mm cameras and films. This was shortly after Kodak had released its new line of Instamatic cameras. For them, the new 26x26-mm film format is a step toward subminiaturizing; Kodak will not discuss the possibility of going any smaller.

Anso's manager for amateur products, James P. Demaree, told me that there is no doubt that subminiature photography will be the wave of the future. The sub-35, which makes images of 18x24-mm instead of the conventional 24x36-mm, is, in his opinion, an intermediate step toward further subminiaturizing. Ilford's George Ashton expressed much the same point of view to me.

At the most recent *photokina*, Zeiss Ikon's director of public relations, Wolf Wehran, told a press party that Zeiss would bypass the split-35 and go instead to 16-mm at such time as marketing conditions are ripe. This is the first time any major camera maker has ever been willing to comment on the subject.

The Instamatic film, called the Kodapak Cartridge, actually is a great tribute to subminiature pioneering. It uses the classic twin-cup drop-in design currently used with the GaMi-16 Minox, Minolta-16, and Mamiya-16 cameras, as well as a number of other cameras no longer made. The coding of the film speed onto the drop-in cartridge was used with the Wilca, a 16-mm subminiature shown at the 1960 *photokina*. The position of the notch (or protrusion) on the film cartridge automatically set the camera's film speed control for automatic exposure control.

In passing it might be of interest to note that other advanced camera features have been pioneered by subminiatures. For example, the Mee-16 SB has a behind-the-lens photocell for more accurate exposure reading of the scene actually being recorded.

I have two predictions to make; perhaps I should offer them as recommendations to the camera industry. They are that (a) having agreed on standards for film cartridge and sizes, they should address themselves to the improvement of film processing services, and the perplexing situations that now exist in mounting subminiature color film for use with standard projectors; and (b) the human hand should be given primary consideration in the design of future cameras (scaling down 35-mm camera systems is not the answer), so that the tiny apparatus can be handled to maximum advantage.

A roundup of cameras

Here's a list of subminiature cameras available in the United States. (Two new ones, the Edixa 16 and the Rollei 16, covered in POPULAR PHOTOGRAPHY's *photokina* report, June, 1963, were not yet on the market when this issue went to press.) The cameras are listed in alphabetical order. Actually, the most popular and most readily available through camera stores are the Minox, GaMi-16, Mamiya-16, and Minolta-16—in their various models. The Minolta-16 has three models currently on the market in the United States, and is said to be the largest selling subminiature in the country today. Source of supply is given for those cameras not easily obtained through camera stores.



MINOX B



MINOLTA-16 EE



MINOLTA-16 P



MINOLTA-16 II

ECHO 8 (Camera Lighter): Built into a windproof-type lighter of standard appearance; uses 8-mm film for 20 exposures, frame size: 6x6-mm; 15-mm $f/3.5$ three-element coated lens with fixed focus, stops down to $f/11$; self-cocking shutter; one speed: 1/50 sec plus T and B, optical reflex viewer; automatic film stop; self-enclosing. Price, \$29.95. Accessories include screw-in filters for black-and-white and color film and infrared and UV filter. From: Silver Bells Ltd., P.O. Box 982, Carmel, Calif.

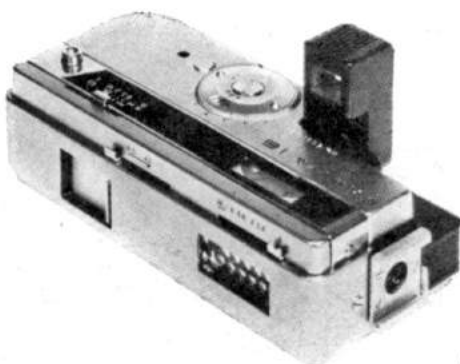
EDIXA 16: (Coming) Uses new standard film load, 21 exposures, 12x17-mm. Lens, 25-mm $f/2.8$ Schacht Travegar. Shutter automatically programmed 1/30 to 1/150 sec, light values 8 to 15. Rapid-wind lever and rewind. Size, 1x1½x3¾-in. Weight, 6 oz. Coupled exposure meter fits on end. Filters, accessories.

GAMI-16: Uses 16-mm GaMi 30-exposure cartridge film, 12x17-mm frame size; 25-mm Galileo Esamitar Anastigmat $f/1.9$ lens, stops down to $f/11$, minimum focusing distance: 20 in.; eye-level combined viewfinder-rangefinder with automatic parallax correction; built-in exposure meter with ASA film speeds 12 to 200 for black-and-white and 20 to 150 for

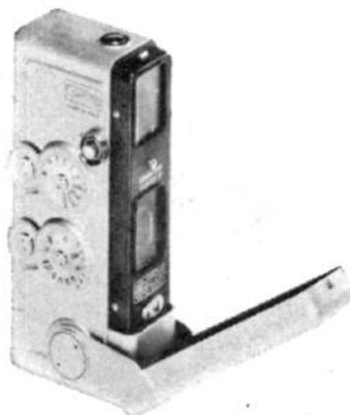
color; exposure control inside finder window; shutter speeds: ½ to 1/1,000 sec and B, EVS settings, combined film/shutter wind, X synchronization; film transport and shutter cocking automatic with camera handle-cover operation; single shots or sequence burst exposures. Price, including leather case, neck chain, and reusable film cartridge, \$299.50. Accessories include 4X and 8X telephoto lenses, copy lens, filters, copy stand, microscope adapter, film loader, film splitter, developing tank, viewer, enlarger.

MAMIYA DELUXE 16: Uses 16-mm film for 20 exposures, 10x14-mm frame size; 25-mm $f/2.8$ coated lens, minimum focusing distance: 1 ft; shutter speeds, ½ to 1/200 sec and B, X synchronization, automatic wind; built-in optical auto-finder with parallax correction; sliding lens cover prevents accidental exposure; built-in interchangeable yellow filter. Price, with case and strap, \$39.95. Accessories available: filters; choice of ten types of film.

MAMIYA ELECTRIC 16: Same features as Deluxe 16 model except with automatic-coupled, built-in exposure meter. Price, including case and wrist strap, \$69.95.



MAMIYA-16 ELECTRIC



GAMI-16

and accessories

MEC 16-SB: Uses 16-mm film; 20-mm $f/2.8$ lens, minimum focusing distance: 1 ft, automatic three-way snapshot settings; shutter speeds, 1/30 to 1/1,000 sec and B, X synchronization; automatic vertical and horizontal parallax correction; lever wind; automatic exposure counter; built-in filter channel. Price, \$84.50; with $f/2$ lens, \$99.50. Accessories include set of seven filters.

MIKROMA II: Uses 16-mm film; 20-mm Mirar $f/3.5$ lens, minimum focusing distance: 18 in., scale focusing; shutter speeds, 1/5 to 1/400 sec, M synchronization; eye-level viewfinder; combined single-stroke film/shutter wind; double-exposure prevention. Price, with case, \$39.50. Accessories include pouch case, developing tank, projector, film cutter, filters, copying system, viewer, enlarger, slide binders. From: Warren Processing Labs, 1924 Ave. U, Brooklyn 29, N. Y.

MINOLTA-16 II: Uses 16-mm film for 20 exposures, 10x14-mm frame size; fixed-focus 22-mm $f/2.8$ coated lens with two close-up lenses; speeds: 1/30 to 1/500 sec, X synchronization; push-pull body cover advances film, winds shutter, protects lens when closed for carrying; retracting film-pressure plate. Price, with case and UV filter, \$39.95. Accessories available include filter kit; filter file; accessory and tripod bracket; B-C 111 folding-type flashgun; enlarger; projector; two close-up sets: (1) with No. 1 and 2 lens, No. 0 distance lens, yellow filter; (2) lenses and 1A filter, 80A and 81B color conversion filter.

MINOLTA-16 E: Uses 16-mm film, 10x14-mm frame size; fixed-focus 25-mm $f/2.8$ lens, minimum focusing distance: 6 ft; shutter speeds: 1/30 to 1/500 sec, X synchronization;

fully automatic exposure control; single-stroke film transport; double-exposure prevention; automatic exposure counter. Price, with case, \$79.50. Accessories include close-up lenses; enlarger; filters for color and black-and-white film.

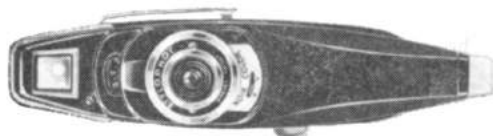
MINOLTA-16 P: Uses 16-mm film, 10x14-mm frame size; fixed-focus 25-mm $f/3.5$ lens (accessory lenses permit close-ups); shutter speed: 1/50 sec, X synchronization; thumb-knob single-stroke rapid film wind; double-exposure prevention; automatic exposure counter. Price, \$26.90. Accessories include flashgun; lenses; filters for color and black-and-white film; projector; enlarger.

MINOX B and PRIVATE EYE: Uses 9.5-mm film; 50 exposures on black-and-white film, 36 exposures on color; 8x11-mm frame size; 15-mm $f/3.5$ coated lens, fixed aperture, minimum focusing distance: 8 in.; shutter speeds, 1/2 to 1/1,000 sec and T, B, X synchronization; built-in exposure meter coupled to shutter; push-pull body cover advances film, winds shutter, protects lens and finder when closed for carrying; retracting film pressure plate; bright frame finder with automatic parallax correction; built-in 2X green, 10X neutral density filters; distance measuring chain for close-ups; satin chrome finish. Price, Minox, \$149; Private Eye, with black finish, \$174. Accessories include Model B B-C flash for AG-1 bulbs with retractable reflector, \$14.95; tripod; telephoto-binocular clamps; copying stand; reflex and right-angle finders; enlarger; developing kit and tank; film viewer-magnifier; transparency viewer-cutter; automatic projector; slide-binding kit; slide file.

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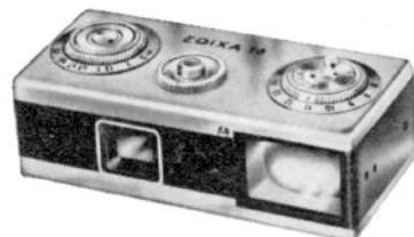
MEC-16 SB



STYLOPHOT



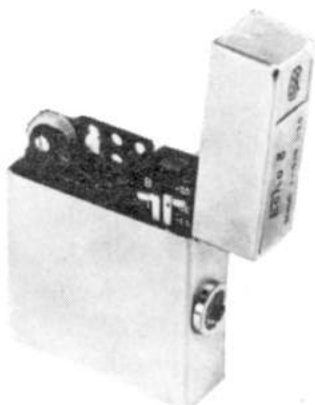
ROLLEI 16 (coming)



EDIXA 16 (coming)



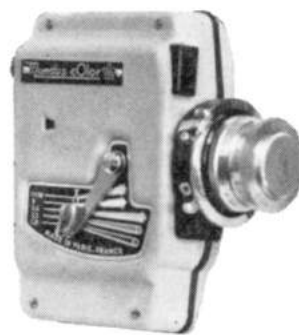
MIKROMA II



ECHO-8



VISCOWIDE-16



MUNDUS

MINOX III-S: Same features as Minox B and Private Eye models but without exposure meter. Has built-in 2X green and 3X orange filters. Price, \$129; with black finish, \$144; with gold-plated finish, \$299. Uses Model A B-C flash for AG-1 bulbs with retractable reflector, price, \$14.95.

MUNDUS COLOR TR-8: Uses 16-mm film, 10x15-mm frame size; 25-mm Roussel *f*/3.5 lens, stops down to *f*/17, minimum focusing distance: 2 ft, interchangeable MC 22.5x50 lens mount; eye-level viewfinder; behind-lens shutter, speed: 1/30 sec, MX synchronization, self-cocking; single-stroke film transport lever with automatic stop and double-exposure prevention; automatic exposure counter. Price, including one roll Mundus Color film, \$86.95. Accessories include ready case, \$12; Roussel 40-mm telephoto *f*/2.8 lens, \$59.50; 50-mm *f*/3.5 telephoto lens, \$64.80; set of close-up rings, \$3.60; flash adapter, \$1.80; flash attachment, \$4.95; MC camera holder; hand strap, \$1.98; camera grip, \$1.95. TR-8 with 20-mm Som Berthiot *f*/2.8 lens, minimum focusing distance: 1 ft, scale focusing. Price, \$119.50. From: Mundus Color Co., P. O. Box 156, Riverdale, Md.

ROLLEI 16: (*Coming*) Automatic-exposure 16-mm subminiature, 1½x-1¾x4¼, 9 oz, covers 12x17-mm on single-perforated 16-mm stock. Focusing with 45-mm *f*/2.8 lens from 16 in., parallax corrected. Push-pull of finder end sets shutter, advances film. Manual operation possible. Film locks on last shot.

STYLOPHOT DELUXE: Uses 16-mm film for 12 exposures, frame size: 10x10-mm; 27-mm *f*/3.5 coated lens, minimum focusing distance: 2 ft, 8 in.; one shutter speed: 1/75 sec, X flash synchronization, automatic wind; ready indicator in viewfinder window; front controls; pocket clip for carrying. Price, with compartment case, \$32.95. Accessories include filters, slide mounts and mounting strips, magnifying table viewer.

STYLOPHOT STANDARD: Similar to Stylophot model but with fixed-focus *f*/6.3 lens; shutter speed: 1/50 sec. Price, with case, \$14.95. Accessories include filters, portrait lens, magnifying table viewer. From: The Kimac Co., Old Greenwich, Conn.; and Silver Bells Ltd.

VISCAWIDE ST-D: Takes ultra-wide-angle 120-degree shots with 16-mm film, frame size: 10x52-mm; 25-mm *f*/3.5 lens; focal-plane shutter. Price, with case, six rolls film, UV and infrared filter, \$39.95. Accessories include filters for black-and-white film, spare empty cartridges. From: Silver Bells Ltd.

The question of FILM...

The availability of film for these cameras is a variable thing. You can get standard Kodak black-and-white film for the more widely distributed cameras, such as Mamiya and Minolta. Anscochrome and Kodachrome II color film is supplied for these, as well, and Agfacolor CN-14, for negative color, is available for all three models of the Minolta. Film for both cameras comes in user-loadable cartridges. GaMi cartridges not only are loadable, but the company puts out a film splitter that lets you slice off a GaMi-size strip from a roll of 35-mm film, as well as a film winder to facilitate loading.

Minox discourages non-factory loading, but puts out a complete range of black-and-white film types (Adox KB14 and KB17, and Kodak Plus-X and Tri-X); plus Anscochrome and Agfachrome CT-18 for color transparencies, and Agfacolor CN-14, for negatives. There is, however, one private supplier of film for Minox cameras. O.B. Photo Products (Box 125, Ft. Hamilton Station, Brooklyn 9, N.Y.) has designed a plastic Minox cassette (the regular ones are metal), and has started loading a line of black-and-white and color film, similar to what Minox puts out. They're being distributed by Caprod, Inc., importers and distributors of Mamiya-16 cameras and accessories. O.B. Products makes and loads the Mamiya cassettes.

Incidentally, this company, which specializes in cutting and spooling odd film sizes (such as those used for the Telstar program) offers to cut and load any film emulsion for any out-of-date subminiature camera, provided the customer can come up with "at least one" empty cassette.

As with black-and-white films, the best results with color are obtained when the finest-grain materials are used. This is much more important as a criterion of selection than in the case of 35-mm color films, where one can worry less about grain and more about tonal characteristics. In portraiture, for example, flesh tones are more important than fineness of grain.

Actually, with close-up portraits, you need not be too preoccupied with fine definition, for you are still achieving over-all effects.

With subminiature films, however, you become much more preoccupied with smoothness of color tones. You don't want them to break apart, thereby coarsening the effect. For this reason, Kodachrome II appears to be a top choice. It is packaged pretty generally for 16-mm cameras, but it is not currently available for the Minox due to processing problems. For the Minox, excellent results can be obtained with Agfacolor CT-18.

So far as picture-taking techniques are concerned, those suggested for black-and-white films are equally valid here if not more so. To some extent, a strong play of color will make up for a loss of picture definition.

For print-making you need finer, sharper films than for screen viewing. Anscochrome is quite satisfactory, since the grain is less noticeable when projected.

...and ACCESSORIES...

Apart from the usual accessories, such as filters and flash units, subminiatures do not, as a rule, have very comprehensive accessory systems. (There are a couple of notable exceptions.) This is quite understandable, since every bit added detracts from the basic advantage of the small, lightweight idea. Since record making is one of the best appreciated functions of the subminiature, close-up and copying equipment are the key accessories. Minox focuses down to 8 inches, needs two supplementary lenses, but attachments are available for Minolta, Mikroma, GaMi, Stylophot, and Mundus. Copying stands are designed to correspond to cameras' distance settings. GaMi film slitter and spool winder let you use any 35-mm film to increase scope. Minox and GaMi offer right-angle viewfinders for very candid photography. Minox also has a waist-level finder, and a belt case.

At present there are only two sources of suitable slide projectors. One is the Minolta Mini-16, which takes standard 2x2 slide mounts with openings for Minox, 10x10-, 10x14-, and 12x17-mm film. The other is the Minox projectors, both automatic and manual, which take 30x30-mm glass slides.

With the growing popularity of subminiature cameras, however, one can expect new dual-purpose projectors. These will enable you to use the same machine for projecting 35-mm films as well as subminiature films. These will interchange projection lenses and condensers. They are among the new things to come, and should take 2x2 mounts.

Subminiature screening and editing is aided by table viewers such as Burke and James' Teleramic, \$24.50, requiring \$3.95 adapter for 16-mm slides in 2x2 mounts.

...and to carry things further

A fascinating accessory for the subminiature is the binocular attachment. As shown here with a Minox, binocular becomes a powerful telephoto lens when attached with Minox binocular clamp. To use, attach with lens set at infinity. Focus through the other eyepiece, and shoot when binoculars are focused. You can, in most cases, retain original speed of camera lens. To compute new focal length, multiply the focal length of the camera lens (Minox's is 15-mm) by the power of the binocular. If this, for instance, is 6x, you have a 90-mm lens. To find your new *f*-value, you divide by the diameter of the binocular objective. That's the second part of the binocular designation. Thus, with a 6x25 binocular you would divide the 90 by 25, which gives you something close to *f*/3.5.



For subminiature close-ups, Cooper used Minox-mounted binoculars for center and right of these three photographs. Normal lens shot, at left, was made from same position as center one, which had aid of 7x50 Bushnell BinoFoto, as did flying horse.



Developing and printing

Most picture-takers prefer to have their films processed for them by commercial finishing or custom services, although the real adventure in subminiature photography, as far as I'm concerned, is in doing your own. It is mostly about the latter that we'll be concerned here.

First, let's cover the commercial photofinishing services. At present, all films packaged for subminiature cameras include instructions and mailers which make it easy for you to send your exposed films directly to an approved finishing lab. Later, the situation may change as films become standardized for a variety of cameras. By then, we hope, lists of qualified finishing services will be compiled for the more discriminating subminiature fans. Better service should then also be available at your local photofinishing "pickup" counter.

But for the present, you're more likely to get good quality service if you take your films to a camera store instead of to the druggist's. In either case, make sure the finishing service to be used *specializes* in subminiature processing.

Also, there are labs that provide excellent mail order service for black-and-white and color, other than Kodachrome. You'll find some of these listed in the classified columns of POPULAR PHOTOGRAPHY. For Kodachrome (which you must load yourself, or have loaded for you by one of the people who specialize in this sort of thing, from double 8-mm or 16-mm spools of movie film) a dependable service is provided by Berkey Photo Service, 77 E. 13 St., New York 3. Price for developing and slide-mounting of a subminiature film is \$1.50. This is the only generally available 16-mm short-length Kodachrome processing service I know of, available through dealers or directly.

At least one custom lab catering to professionals (Motal Custom Darkrooms, 13 W. 46th St., New York 36), recognizing the popularity of subminiatures among both pros (as a second camera) and amateurs, has instituted a subminiature *developing and proofing* service that simplifies "finding out" what you've shot. Film is developed, fine-grain or compensating, for 80 cents a roll and same-size contact sheets cost 30 cents each. However, they'll enlarge an entire roll (or more than one, but the more negatives the smaller the individual pictures) at once to give you a fair-size blow-up version, so that each frame can be viewed with the naked eye. An 8x10 "enlarged contact" costs \$1.50; 11x14, \$2, and 16x20, \$4 per sheet, regardless of how many rolls of film are included on any one. Cut up, these make adequate wallet-size prints.

If you have an enlarger that will take a 4x5 negative carrier you can do this yourself. Simply sandwich the negatives between glass and insert in the negative carrier of the enlarger.

Developing subminiature film is basically like processing 35-mm film. The chief differences are in the tanks, loading the reels, and in the greater care that must be exercised

throughout the entire cycle of developing and enlarging in order to overcome the hazards of dust and scratches. The point to remember is that dust remains constant in size, as does a fingernail scratch; as the negatives get smaller and require more enlargement, the annoying spot that might squeak by with a larger film becomes devastatingly conspicuous.

The Minox film is most easily developed in a Minox daylight developing tank, although professionals who do a lot of work in Nikor tanks can obtain special Minox reels. For daylight loading of 16-mm reels, there is the GaMi 16 tank, and for a darkroom loading alternative, you can use the FR Special developing tank with a special flange that lets you develop two rolls at a time. Also, Nikor makes 16-mm reels, and they can be used with any of their tanks.

The same rules that govern choice of 35-mm developer hold good here. For slow films, a diluted compensating developer should be used, while any of several fine-grain developers can be used with the faster films. Slow films can be made "faster" with some developers, such as Acufine and Diafine, while retaining their fine grain and sharp edge qualities.

Developed films should be given a final rinse in an anti-static wetting solution, then hung up for quick drying. Dried films should be cut and filed in negative sleeves. Paper sleeves designed for 35-mm will do nicely if staples are put through the center of the sleeves, dividing them in half lengthwise. Warren Processing Labs, 1924 Avenue U, Brooklyn 29, N.Y., is a source for 16-mm filing wallets, at 12 cents each by mail. Minox film wallets are available from Minox camera dealers.

There are only two enlargers made specifically for subminiature negatives—Minox and GaMi 16, both of which are precision instruments with features designed for their small negative sizes. The Minox enlarger may be used also with 10x10-mm formats on 16-mm, thereby accommodating the Stylophot and the models of the Minicord still found in circulation. There are several enlargers that are accessory-interchangeable between 16-mm and larger sizes, by use of film carriers and masks, as well as shorter-focal-length lenses (and sometimes other condenser assemblies). These include the Axomat Ia, Beseler (all models), Bogen Sub II, Durst (several models), Minolta-16 (which doubles on 35-mm), and Omega A2.

Carlwen Industries, 18 Grandin Circle, Rockville, Md., makes scratch-proof, rapid-shift negative carriers for a number of different enlargers. There are 16-mm carriers available on order for some.

All work should be in a dust-free, draft-free darkroom area. Three important working tools are a camel's-hair brush, liquid film cleaner, and liquid scratch remover.

Any enlarging papers can be used, although the subminiaturist may prefer matte or silk finishes.



Print or transparency, subminiature color keeps pace with the medium's development. Harbor scene, above, comes from an Agfacolor negative made with a Minox by R. Stephen Vercoe, a New Yorker who just happened to have his subminiature camera in his pocket when he happened upon these fishing boats during a Sunday morning stroll in Sesimbra, Portugal. The sleepy landscape, at right, was made on Kodachrome II, daylight type, with a GaMi-16 by author Cooper, who wouldn't venture anywhere without at least one subminiature on his person. Strips show actual size of GaMi-made transparencies (on Kodachrome II) by Cooper.

