

Kodak Discomania at the Plaza

Administering the coup de grace to 110,
the long-awaited miniature film-disk system
includes amazing new technology

By Arthur Goldsmith

Under the crystal chandeliers of the Plaza Hotel's Grand Ballroom in New York, and in 40 other locations around the world, Eastman Kodak on Feb. 3 finally launched its new, ultraminia-ture-format disk system. After years of rumor, speculation, and study of patent disclosures by innumerable industry disk-watchers, the general features of the new system came as no great surprise. However, the details of Kodak's achievement revealed an impressive research-and-development effort resulting in remarkable technological achievements that promise future spinoffs.

Small and flat enough to fit into a shirt pocket and using a wafer-thin disk containing 15 tiny (8x10-mm) frames of a new, high-resolution ASA 200 Kodacolor film, the cameras have a look akin to that of a pocket-transistor radio or calculator. The first response of a number of nonindustry people we've shown the camera to has been, "I want to get one for my wife." Although this smacks of unregenerate male chauvinism, it's exactly what Kodak is aiming for. The Disc is designed to appeal to the broadest possible market, especially to people intimidated by any hint of technical complications in their snapshooting.

A sophisticated 12.5-mm f/2.8 four-element glass lens, lithium batteries with a life expectancy of more than five years, a built-in flash that recycles in little more than a second, automatic exposure, and automatic film advance are combined to provide what, in Kodak jargon, is called "decision-free photography." Fortunately, the two

central esthetic decisions—how to frame the scene and what instant to record—are still left to the photographer. But the advertising slogan that first made Kodak famous lives in a new guise of high-tech wizardry. With the Disc, you push the button and it does the rest.

The press kit distributed at the conference weighed some 3½ pounds, more than eight times heavier than the camera it described. Although studded with technical and marketing jargon, it made fascinating reading as it revealed, with frequent quotes from the people concerned, the problems, research, thought processes, and solutions involved. If nothing else, the development of Kodak's Disc is a classic case of the matrix approach to a major design project. For more details, plus reactions and comments by POPULAR PHOTOGRAPHY editors, see the reports on the following pages.

The Disc debut was only the climactic event of an extraordinarily hectic week of product previews prior to the big annual PMA trade show and convention in Las Vegas, Feb. 17-21. Canon introduced its AL-1 autofocus-aid update of the AV-1. Nikon unveiled the FM2, a professional-level SLR with a new titanium shutter delivering a top speed of 1/4,000 sec and a flash-synch speed of 1/200 sec, plus a programmed update of the FG. Minolta introduced several new cameras to the U.S. market. For more about these plus other late-breaking products, read on. Our first-hand report on the big Las Vegas show itself will appear in next month's issue. ○

For the Space-age Snapshooter

The Kodak Disc 4000, 6000, and 8000 cameras provide utter simplicity through sophisticated design

By Don Leavitt

Imagine that you're a research scientist who has just been given the following assignment: design a mass-market-priced camera/film system that: 1) is truly lightweight and pocket size; 2) requires absolutely no user decision-making other than selecting the scene and pressing the button; 3) requires no other user action besides loading and unloading the film, and taking the picture; and 4) that will produce good pictures in virtually any lighting situation.

Imagine further that you were told you may design this camera/film system completely from scratch, not being bound to any existing technological precedents in camera/film design.

What do you think you might come up with?

System description

Kodak scientists spent the last five years tackling exactly this problem, and they came up with the remarkably innovative disk camera. This is a very small, compact, lightweight camera about 4¾ in. long, 3 in. high, and 7/8 in. thick—just about the size of a pocket calculator—weighing 6½ oz. (barely an ounce more than a 110 pocket camera). The camera also includes a built-in automatic flash with a slightly longer than one-sec recycling time, automatic

exposure control, a fixed-focus f/2.8 lens, and motor drive to advance the film automatically after each exposure.

The high-speed Kodacolor HR film used by this camera is perhaps the most revolutionary part of the system. The negatives are laid out in circular form around the periphery of a 2½-in.-diameter circular plastic disk, like spokes in a wheel. This film, including 15 frames to the disk, comes encased in a flat plastic cassette, which is easily inserted into the camera by drop-loading.

What distinguishes the disk camera/film system from all others is the total impact of the film and camera attributes described above. By themselves there is nothing particularly new about any of the automatic features listed here. And there is nothing new about having a very small, lightweight camera. What *is* new is the synergy between each of the features. Together they produce a completely automatic photographic system that aids the user to take good pictures in almost any kind of lighting situation, merely by aiming the camera and pressing the shutter button.

To get a better sense of how all the aspects of the disk system interact to produce this result, let's start by looking at how Kodak came up with the

idea of the film disk itself. This evolved through a step-by-step analysis based on an integrated systems approach, as follows:

1) Because Kodak wanted a small camera, they needed to use a small negative.

2) Because the negative had to be small, its sharpness became much more of an issue than with larger formats.

3) The best way to assure sharpness is to make the negative lie absolutely flat in the focal plane of the camera.

4) With small, cassette-loading cameras, such as the 126 Instamatic or 110 pocket types, it is difficult to use a conventional film channel to keep the film absolutely flat.

5) Another alternative was to make the film *thicker* to provide the required dimensional stability and film flatness.

6) Therefore, they coated the new Kodacolor HR emulsion on Estar, a 7-mil-thick base. Estar is a heavyweight polyester often used as the base for Kodak 4x5 and 8x10 sheet film.

7) However, 7-mil plastic will neither turn a corner nor wind around a spool of the size you would find inside a small camera. Kodak researchers *had to figure out an alternative to roll film for advancing the film from frame to frame.*

8) Kodak's scientists quickly discovered that the best solution was to revise the concept of the old Viewmaster approach, of placing a ring of slides around the edge of a flat disk. *Once this disk format was adopted, the rest of the camera had to be designed around it.*

Lens

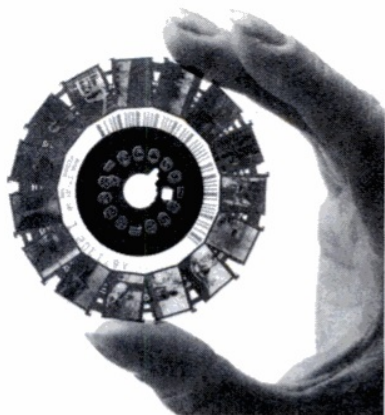
The lens design, for example, which was dictated by the disk format, resulted in a perfect marriage of small size and superb sharpness.

1) The small negative (8x10 mm) necessitated using a lens with a very short focal length, 12.5-mm. That gave the benefit of much greater *depth of field* than would be possible with the longer lenses found on the 126- and 110-format cameras. In practical terms, this means a fixed-focus lens that provides acceptable sharpness from four feet to infinity.

2) Because the focal length was so



From left to right: Kodak Disc 4000, 6000, and 8000 cameras. All are powered by long-lasting lithium cells. Bottom center, Kodacolor HR Disc Film.



This is how a processed 15-exposure disk negative looks.

short, it enabled the designers to make the camera thinner, which was exactly what they wanted. In fact, the total distance from the front surface of the lens assembly to the film plane is just 15 mm (or slightly less than $\frac{5}{8}$ in.). Furthermore, this compact lens still provides a 58-degree field of view.

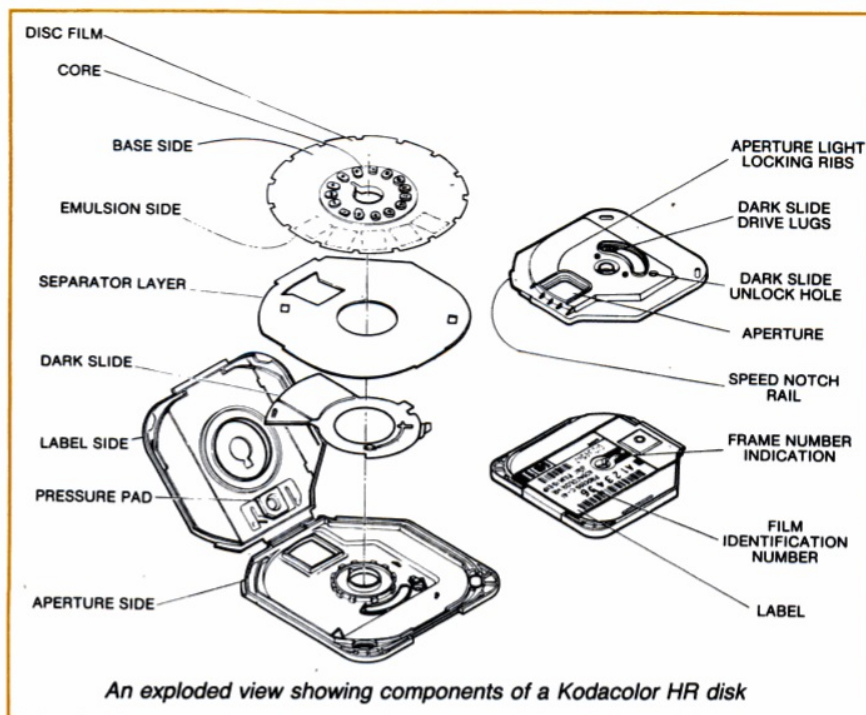
3) Another benefit of such a short-focal-length lens is that it becomes easy to make it a high-speed lens. As a result, Kodak's lens designers were able to make the disk camera lens at $f/2.8$, which buys $2\frac{1}{2}$ stops more shooting room than is now possible with Kodak's low-priced 110 cameras.

4) The lenses are made out of four separate coated glass elements, including one aspheric element to get the maximum sharpness and minimize lens aberration. As my colleague Norman Goldberg pointed out, the disk camera lens is in effect a high-quality microscope objective.

Film

To increase the scope of the Kodak disk system, the sensitized emulsion for it was redesigned in many respects. The film emulsion not only had to be a stop faster than the current generation of Kodacolor film, it also had to have significantly improved sharpness as well as much smaller grain to make high-quality enlargements from the small negative used in the disk system.

The wide variety of scene illumination encountered, ranging from a single lamp in a living room to outdoors on a sunny, snowy day, requires extremely wide exposure latitude. To facilitate this, Kodak's scientists made several changes in the various layers of the previous Kodacolor II film. They increased film speed (or light sensitivity) while actually reducing grain size, by materially changing the film chemistry. Second, they coated the emulsions onto



the film in much thinner layers, thereby ensuring increased sharpness.

Finally, to both increase sharpness and extend the exposure latitude of the film, Kodak used special chemicals called Development Inhibitor Release Couplers (DIRs) which minimize light scattering in the emulsion as well as the effects of overexposure. As a result, Kodacolor HR film can be overexposed by up to three f-stops and underexposed by up to two stops, and still produce acceptable pictures.

As an added bonus, this new film technology holds great significance for the future of photography in general, because it means that Kodak may soon be introducing color-negative films in 35-mm and 120-roll film, and sheet film sizes, which will offer the advanced amateur and professional photographer the same desirable improvements as are now being introduced in the new disk-camera film.

But that's not all. Because Kodak's scientists had an open field, free of traditional constraints, the disk system contains still more innovative features.

Battery

Perhaps one of the most spectacular innovations incorporated in the disk system is the use of high-power, extremely long-life lithium batteries. Manufactured for Kodak under contract by Matsushita Electric of Japan, the "Ultralife Energy Source," as Kodak calls it, is guaranteed to work for five years or 2,000 exposures (133 disks of 15-exposure Kodacolor HR disk film)—far more than the expected aver-

age use. At the end of five years, or whenever the battery runs out, which could be quite a bit longer than that, the user simply brings the camera to a dealer or Kodak service center for battery replacement.

I have gathered that Matsushita will probably make these batteries available to the rest of the camera industry in a new cell size which, we expect, will have interesting implications for automated 35-mm photography.

Photofinishing advances

Still another striking advantage of the disk-film system is that it provides some very important benefits to commercial photofinishers. Each disk of film has a unique serial number which is printed on both the outside of the cassette and on the film itself, in both Arabic numerals and computer-readable Standard Product Code. In addition, each individual negative is numbered 1 to 15 in both Arabic numbers and optically readable binary code. This effectively eliminates the possibility of lost or misplaced film or other mistakes made during the photofinishing operation. (Needless to say, special new equipment must be employed by photofinishers to develop and print disk film.)

One new important feature of the disk system is that prints made from this film will automatically have the correct negative number printed on the back of each picture, and the date.

To further simplify handling, Kodak has designed a cardboard envelope in

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Snapshooter

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which the processed film is returned to the photographer along with his finished prints.

If he wants multiple copies or enlargements of any prints, you simply note this information on a table preprinted on the back of the envelope and return the disk in its unopened envelope to the printer. This system eliminates the need for the photographer to ever touch the disk itself. Another important feature of the disk is that it contains a magnetic coating that allows the photofinisher to encode printing instructions electronically.

This capability has intriguing implications for the future. Kodak intimated at a recent press conference that some day it will be possible to view disk images on a home television set for both viewing and for making decisions about cropping and enlargement, which can then be similarly encoded on the disk so as to provide the photofinisher with these instructions.

The cameras

Featuring a 12.5-mm f/2.8, four-element coated glass lens, the Kodak Disc 4000 camera has an automatic exposure system to adjust aperture and shutter speed for any kind of lighting. For photographs under 125 footlamberts (overcast or open shade) or indoors, the camera automatically flashes at f/2.8 at 1/100 sec in the range of four ft. to 18 ft.; above 125 footlamberts, the camera automatically makes an exposure at f/6 and 1/200 sec.

The 4000 contains its own six-volt lithium energy source that is activated by simply touching the camera. Outdoors, the 4000 can shoot up to three pictures per second without flash. Indoors, the camera can shoot slightly more than one picture per second.

In both cases, the motorized drive eliminates the need to worry about film advance. The 4000 uses a sliding lens cover to protect the lens and viewfinder, and also to turn the camera off. Its suggested list price is \$67.95.

Offering all of the basic features of the 4000 camera, the Kodak Disc 6000 model has a cover over the entire front of the camera. In the open position the cover serves as a handle and activates the camera's main power. The 6000 also includes a close-up feature, allowing the user to move in as close as 18 in. to the subject. If close-up pictures are desired, the user simply slides the close-up lens into position. This adjusts the lens focus, re-aims the viewfinder reticle, and indicates that the camera is in the close-up mode by a viewfinder signal. The camera's range in the close-up mode is 18 in. to five ft.

The camera returns to normal focus when the close-up slide is returned to its regular position, or when the cover of the camera is closed. The 6000 has a suggested list price of \$89.95.

The Kodak Disc 8000 camera has the features of the 6000 plus a self-timer, rapid-sequence film advance, digital alarm clock, and gold-anodized appearance. Sliding a switch near the lens puts the camera into the self-timer mode. This allows a 10-second delay before the exposure is actually made. The self-timer operates with a blinking red light on the front of the camera and generates an audible signal that lets you know when the exposure is about to happen.

The rapid-sequence shooting feature allows the user to take a series of pictures while simply holding the shutter button down. The exposure rate is about three frames per sec in daylight, and one flash picture every 1 1/3 sec in low light. The camera is placed in the rapid-sequence mode by sliding a switch near the lens.

The digital alarm clock, with self-contained power supply, is in the cover handle. Two switches allow the user to display clock time or alarm time and to set clock time or alarm time. Featuring a lustrous, durable, gold-anodized aluminum front panel, the 8000 has a list price of \$142.95.

One 15-exposure disk of Kodacolor HR film will sell for \$3.19; a two-pack for \$5.90. The system will be available nationally May 17. ●

Can You Develop and Print Kodak Disc Film in Your Home Darkroom?

Yes, indeed, if you have the right-size pencil and an electric drill.
For best prints you'll also need a very bright diffusion enlarger

By Bob Schwalberg and Walter Johnson

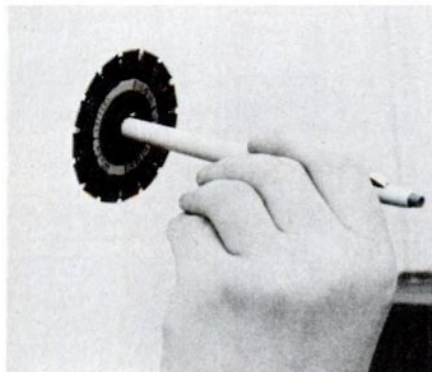
Souping your own Kodacolor HR Disc films calls for one standard Kodak Flexicolor (C-41) processing kit, a suitably sized plastic pencil to jam into the disk hub, and an electric drill. The pencil is your processing rod, which Walter Johnson kept twirling throughout the standard 3¼-minute development, changing direction to avoid potential flow marks. The drill? For drying, natch. Kodak's new Disc processor will spin at 2,000 rpm, which is close to what most home-handyman electric drills do. Chucked with polishing or sanding attachment to prevent their flying off, drying seems to take about four minutes.

Printing the little negs presented only one problem—not enough light from standard dichroic diffusion heads, like the Chromega on Walter's venerable Omega D-2. This caused us to switch the condensers, and the more sharply collimated light increased the graininess. The negatives are phenomenally sharp, but 13x16-cm blowups demonstrate the need for a bright diffusion head.

Filtering was no problem, for Walter,

that is. First guesstimation was 20M plus 40Y, and fine-tuning called for 25M and 35Y. For a 16X magnification Walter ran the D-2 head up to the top of the column, using a 50-mm Componon-S lens at f/4 with a 10-sec exposure.

Kodak may not have intended anything like this, but wetside processing of the new Disc film is so pleasurable that a lot of home color workers might like to try stretching the little 8x10-mm negs themselves. ○



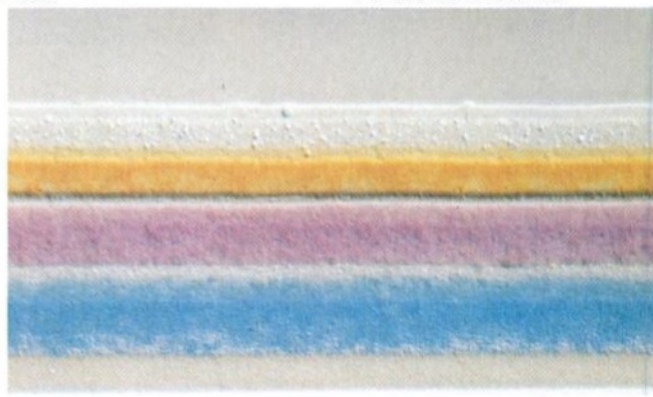
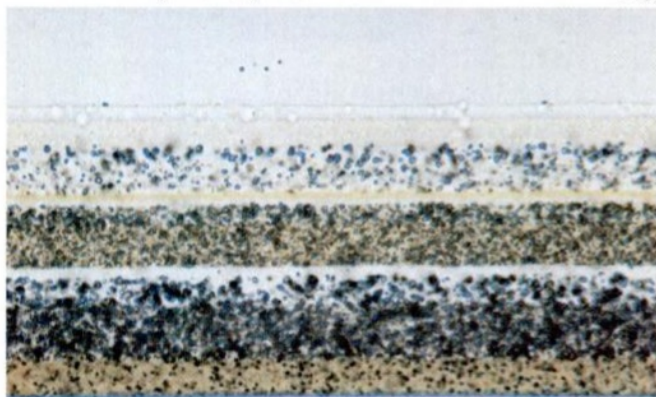
Spin on a pencil.



Dry on a drill.



Look Ma, no hands!



The secret of Kodacolor HR Disc film sharpness lies in its new thin-layer construction shown in these cross-sectional photomicrographs of unprocessed (left) and processed (right) negatives. From top to bottom these are yellow, magenta, and cyan layers

reproduced at a magnification of about 4,000X. All layers above the base have a thickness of about 0.001 in. (0.0254 mm), and the remarkable Kodak Disc-camera lenses are accurately prefocused onto the central, magenta image layer.

The Disk

The anticipated explosion began, with new models from Europe and the Far East, plus some intriguing accessories

By Kenneth Poli

Competitors added something new this year to Kodak's "decision-free" Disc photography: decisions. A large gadget-bagful of new models from several manufacturers was offered, plus add-on wares to at once enrich and encumber the photographic lives of snapshotters the world over.

The two largest surprises came from Minolta, whose reliably rumored disk camera did *not* appear, and Osram, the lamp and flash manufacturer, whose totally unexpected model *did*.

Many of the new models, presumably made to be attractively priced, are powered by user-changeable AA cells, and have flash warning lights rather than monitoring circuits that automatically cue in flash function at low-enough light levels. Once warned by the electromechanical watchdogs of his disk camera, the user must decide whether to actuate the flash, change the batteries, etc.

Other units feature finger-powered film advance, forcing one to decide whether that extra shot is truly wanted before readying the camera to take it.

Not all of the new arrivals seem scheduled to make exposures in the U.S. One that will, however, is **Osram's** surprise entry, the **Flash-Disc**. It compares to the Kodak 4000 in most ways, but has an interesting slide-down section on one end of the chassis that both uncovers the flash unit and actuates it while providing a grip by which to hold the camera firmly.

Closed, the handle cancels and covers the flash head. Flash is not automatically engaged, however. A warning sensor turns on a red light, signaling you (decisions, decisions, decisions!) that flash is needed to get proper exposure. You must then use an on/off switch to engage the flash unit. Four manganese-alkaline AAA batteries power the unit.

Deliveries to the U.S. will begin in spring of this year; price is not available.

Other disk cameras seen that will be available in the U.S. came from Hanimex, Haking, and Prodev International Ltd. Some were described in our preshow report in October.

Haking, for mind-reeling example, has nine (!) models besides the Ansco HR30 and HR50 we described in the

show preview. But most are **two-color variations of the HR30**. A letter added to the model number will identify whether the second color is red, black, "champagne," metallic blue, silver, or charcoal grey. Deliveries are due to begin now. Price of the HR30 models will be about \$59.95.

An **HR20** model, also scheduled for immediate delivery and priced at \$39.95, is powered by two AA cells and has a manual film advance. An **HR40** model, also powered by two penlight cells, features an electronic flash that is automatically sensor-controlled. It will retail for \$69.95.

Two more units to be called (at least on the samples I saw) the **Ansco Disc 105** will also appear. One of these accepts FlipFlash units, the other has a hot shoe for electronic flash. Both call for manual film advance and have f/3.5 lenses. A matching electronic-flash unit will be available for the hot-shoe model, but prices are unavailable.

Hanimex showed two disk models—the **320** and **420**—and (dare I say it?) is taking the plunge with an underwater housing for Kodak's 4000 camera.

The **320** has automatic film advance, an f/2.8 lens and built-in flash, and is powered by two AA cells that can recycle the flash in two sec. A warning light tells when flash is needed.

The **420** is like the **320** except that its flash operates automatically when light conditions call for it. The two-cell power source is claimed to rotate 50 disks of film and fire accompanying flashes before calling for new batteries.

As mentioned in our October preview, **Prodev International Ltd.** showed three **Prolux** disk camera models that will presumably appear under the names of other companies. The simplest model, the **Disc 100** has an f/8 lens, motor-drive film advance and built-in flash, and is powered by two AA cells.

The **Disc 300** has an f/5.6 lens plus close-up lens and built-in flash with warning sensor system, and is powered by a nine-volt battery.

Top of the Prodev line, the **Disc 800** has an f/2.8 lens plus close-up lens, two-stop automatic sensor-controlled expo-

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Osram Flash-Disc



Hanimex 420



Prodev's Prolux Disc 200S



Continental Disc/Flash 201



Achiever DC 830

sure system, automatic on/off-as-needed electronic flash, built-in self-timer, and nine-volt battery power.

Prodev's **Disc 200S** is, I think, unique in having been designed to be used either outside or inside its accompanying watertight (to 12 ft.) plastic all-weather housing. It has an f/5.6 lens, motor-drive film advance, built-in flash, and nine-volt battery power.

Add to the U.S.-bound disk cameras the long-promised, yet-to-appear line from **Continental Camera Co.** These will be the **Disc/Flip 101**, **Disc/Flash 201**, **Disc/Matic 401**, and the **Disc/Star 601**. Delivery at show time was promised for October 1982, beginning with shipments of the 201 model.

All models feature a four-element glass f/2.8 12.5-mm lens, motorized film advance, and 1/250-sec shutter speed. The 101 and 201 are each powered by two AA cells, while the 401 and 601 use two included lithium batteries apiece.

The 201, 401, and 601 offer built-in electronic flash with recycle times from one to two sec, depending on the model. A fascinating specification given for the **Disc/Flash 101**, which lights up the world solely with eight- or 10-shot **FlipFlash** bulbs, is an attributed recycle time of 1½ to 2 sec—a possible technological breakthrough for conventional flash.

List prices for the units, from 101 to 601, will be \$29.95, \$39.95, \$49.95, and \$59.95, respectively.

Another group of jumpers-onto-the-American-market disk bandwagon are cameras from **Achiever Photographic (U.S.A.) Corp.** Two models, the **DC 800** and the **DC 830**, were promised for November 1982 delivery. Although both have manual film advance, the 830 has built-in electronic flash, while the 800 does not. Both use an f/2.8, 12.5-mm coated glass lens. The 830 shows a red warning light when flash is actuated by a separate on/off switch. The 830 has no attached handle/cover; oddly, the lower-priced 800 does.

Several companies showed disk cameras that will *not* be imported into the U.S. Among them were **Regula-Werk-King**, of Germany; and **Nova Cameras** of England.

But even more interesting than the new disk models was the group of accessories offered to load down "decision-free" photographers.

For those wanting to go off the deep end, Hanimex will provide their **Penguin underwater housing**. It will keep the Kodak Disc 4000 dry down to 13 ft. underwater. Price, \$22.95. Landlubbers, on the



Hanimex Penguin underwater housing

other hand, can clip onto their belt Achiever's plastic **Disc Camera Carrier** for all Kodak (and Achiever) disk models. Another Achiever achievement is a small **Disc Film Cassette**, in which developed disk film can be stored and inspected frame by frame to select frames for enlargement without endangering the film by extra handling. Frames can be inspected by rotating the cassette cover to bring them successively into view in a window in the cassette cover.

And you say you're bored with the same old normal-lens field and "look"? Well, cousin, did the *photokina* produce auxiliary tele and wide-angle lenses for you! **Kenlock**, whose U.S. distributor is **Rokina Optical Co., Inc.**, has an **afocal tele lens** of 1.5X and a **wide-angle** ditto of 0.7X to enlarge or reduce the image size of all present Kodak Disc models. The lenses are each in a plastic frame that also contains a viewfinder mask. In use, each is slipped in front of the prime lens and held in place by the grip of the auxiliary lens mount on the short edge of the disk-camera body.

Ambico's Discovery Kit, for delivery just about now, brings you three **special-effects attachments** to help push your disk a little further toward the Big Leagues. Each snaps over the front of the lens and viewfinder simply and quickly. Included are an image-doubler, a sepia filter, and a star filter. List price for the kit of three special effects is \$17.95.

Several other companies offered slip-on wide-angle and tele lenses, but availability in the U.S. was not decided at *photokina* time.

Other disk technologies revealed at The Big Show on the Rhein (and covered in more detail by Don Leavitt, elsewhere in this report) were Kodak's demonstration of how they are able to display Disc photos on a TV screen complete with zoom-in and scanning possibilities for cropping in preparation for printing. Kodak, however, stressed that the demonstration showed only "a product possibility." Uh-huh.

Also, Fuji announced their achievement of a new disk film of their own formulation but were skimpy on details. Sample prints displayed looked fine, but

it will be a while before anyone can buy or test it in the U.S. The disk, it would seem, is becoming an ever-widening circle. ●