Chapter 6
Underwater Photography

It is hard to imagine a more difficult endeavor than taking pictures underwater. You have to be at least partially crazy to get involved in it, and if you are not crazy when you start, it is virtually guaranteed to make you crazy. First, you have to learn to survive in an alien environment. Before you even think about the highly specialized photographic equipment required, you have to learn how to safely breathe and move about underwater. That means you have to become a certified diver. The most important qualification required to become a good underwater photographer is to be a good diver. You can't worry about things like f-stops, depth of field, shutter speeds, exposure, point of focus, and other technical photographic stuff if you are not comfortable underwater. Things like breath and buoyancy control, awareness of time, depth and tank air pressure, must become second nature, like shifting while driving a car with a manual transmission.

Underwater photography, even with excellent diving skills, state-of-the-art equipment, and plentiful subjects, is still a very low batting average endeavor. You fail much more often than you succeed. That means that you discard a ***lot*** more images than you keep. But the occasional "keeper" can make up for all the throwaways. Underwater photography offers the highest highs, and the lowest lows of any endeavor I know. Everything in underwater photography is stacked against success. First, unlike taking pictures topside, you have a very limited amount of time to capture your image (before you have to surface or drown.) Whatever underwater subject you are seeking on each dive, you have to find it in less than an hour, you can't hang around all day waiting for something to appear. Second, from an equipment standpoint, you are working in a very hostile, corrosive environment. The basic camera mechanisms and electronics must be protected from ***any*** contact with salt water. This means sealed "housings" that contain and protect the camera itself, requiring intricate sealed control linkages between the housing and the camera buttons and dials, all subject to mechanical failure or leakage. The housing I currently use has 32 holes through it for control mechanisms, latches and ports, each with an o-ring to seal out the salt water, each subject to leakage. That's a lot of potential leaks.

Pam bought me my first underwater camera in 1980. She doesn't like to talk about that and rarely admits it, but it is in fact true. When asked about it, her typical answer is, *"what was I thinking?"* The camera was a Nikonos III, one of the first of the classic line of submersible 35mm underwater "viewfinder" cameras marketed by Nikon starting with the introduction of the Nikonos I in 1963. When describing a film camera, the dimension "35mm" refers to the width of the film strip, in millimeters, used in that camera. When referring to lenses, the dimension refers to the focal length of the lens (15mm, 20mm, 300mm, etc.) Lenses with short focal lengths (10.5mm, 15mm, etc.) are "wide-angle" lenses; lenses with long focal lengths (150mm, 200mm, 300mm, etc.) are "telephoto" lenses. "Submersible" means that the camera doesn't require a separate housing. All internal mechanisms and parts are sealed with rubber o-rings in the body of the camera itself. "Viewfinder" refers to the fact that the image is viewed not through the lens, like with single-lens-reflex (SLR) cameras, but through a viewfinder mounted above the lens. That means that what you see through the viewfinder is not precisely what the film sees when the shutter is open. This is referred to as "parallax." The difference in the two "views" is more pronounced the closer you are to the subject. Thus, with a viewfinder camera, it is more difficult to precisely compose a close subject than a far subject. With an SLR camera composition is precise at all distances because you are looking through the lens and your eye sees exactly what the film sees.

Nikonos III with 35mm lens (photo from Nikon archives)

The Nikonos III (introduced in 1975) was followed by a IV (1980) and a V model (1983), each with more electronic bells and whistles, each more vulnerable in case of a leak. The IV model was actually called the “IV-A” with the “A” suffix indicating that the camera had, for the first time, a built-in light meter with an automatic TTL (through the lens) exposure control system. I had a IV-A for a short period of time, but it was only produced for about three years before it was replaced by the V in 1983. I’m not sure what happened to my IV-A, I am a packrat and hardly ever get rid of my equipment no matter how obsolete. But there is, in fact, no IV-A on my shelf. Here’s what it looked like:

Nikonos IV-A with 35mm lens (photo from Nikon archives)

The Nikonos V was widely used by both amateur and professional underwater photographers for many years. I have owned four Nikonos V cameras and still have two today. The Nikonos cameras are magnificent pieces of equipment, reliable, and durable. Nikon made several high-quality interchangeable lenses for the "V," the "standard" 35mm lens which can be used both in water and air, and three wider lenses, the 28mm, 20mm, and the classic 15mm, each corrected for use in water only. Nikon also made an 80mm Nikonos lens, but long lenses are of little use underwater and I don't think I ever saw an 80mm lens outside of a camera store. All of the Nikonos underwater lenses had superb optics. Here's a picture of the Nikonos V with the 35mm lens:

Nikonos V with 35mm lens (photo from Nikon archives)

When you are more than just a few feet underwater everything, even brightly colored things, look like they are a dull greenish gray. When you see blood underwater it looks green. I won't go into the physics of that (as if I knew), but I ask that you accept it as fact. Shine a light on those dull-colored underwater objects, however, and the reds and yellows pop out. To bring out the beautiful colors underwater, photographers bring artificial light down with them. Artificial light is light that does not originate with the sun. The artificial light is produced by devices called "strobes," and they are essential to most underwater photography. Underwater strobes come in various sizes and powers. Smaller, lower powered strobes are generally used for close-up, or "macro" photography, larger higher powered strobes are used for wide-angle photography. Power is provided by either regular batteries (typically AA) or custom rechargeable battery packs.

Strobes are physically attached to the camera or camera housing with a variety of articulated arms and brackets, generally made of aluminum, some of plastic. The arms and brackets allow precise positioning and aiming of the strobes. Electronically the strobes are connected to the camera system with waterproof cords. Most experienced underwater photographers use two strobes, one on each side of the camera. This allows even lighting

on the subject and avoids harsh shadows on one side. In my career I have used strobes from three companies, Nikon, Ikelite, and Sea and Sea.

Ikelite 50 "small" strobe – 4 AA batteries

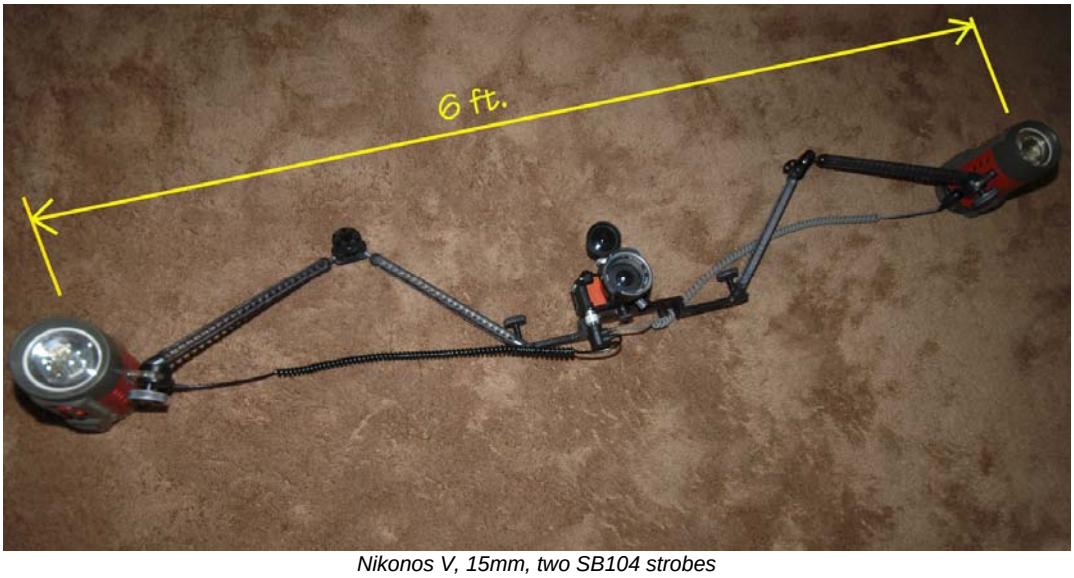
Nikon SB105 "small" strobe – 4 AA batteries

Nikon SB104 "large" high-powered strobe - rechargeable battery pack

Underwater photography has historically been divided into two broad categories, close-up or "macro" photography, and wide-angle photography. There is an intermediate category, fish photography, which combines aspects of both but is more closely related to the close-up category. The classic wide-angle lens for the Nikonos camera was the 15mm. It was a rectilinearly corrected lens, not a fisheye. That means that straight lines in the real subject stay straight in the image. The optics of the 15mm lens are fantastic. It was extremely sharp and had tremendous depth of field, almost everything from the lens to infinity was in acceptable, if not precise, focus, even at larger apertures. It came with a viewfinder that was mounted on a shoe at the top of the camera body. While precise composition is not critical with an angle of acceptance of 94 degrees, the viewfinder was still a great help. Some of the best wide-angle underwater photographs ever made were made with the 15mm lens.

Nikonos V with 15mm lens and dedicated viewfinder

For wide-angle images, before (and occasionally after) changing to a housed SLR system, I usually used the Nikonos V/15mm lens combination with two of the large, high-powered strobes, either the Ikelite 150/225 or the underestimated Nikon SB104. Contrary to a generally held and publicized opinion, I later learned that high-powered strobes are not necessary for good wide-angle underwater images. The subjects you want to light, or even ***can*** light, with the strobes are relatively small and close to the lens. Small strobes, properly aimed, are fully adequate for this purpose, but it takes some practice. To avoid illuminating particles in the water between the lens and the subject, I wanted my strobes to be as far from the camera laterally as I could get them, and aimed not directly at the subject, but straight ahead. This, if you do it right, creates a cone of non-illuminated space between the camera and the subject, lighting the subject but not all the stuff in the water in front of it. Here was my setup with two Nikon SB104's mounted on the longest arms I had. With the strobe arms extended, as shown in the photo, the strobes are slightly over 6 feet apart:



Nikonos V, 15mm, two SB104 strobes

This arrangement looks terribly awkward, and in air it is. In fact it would be virtually impossible to hold the strobes in this position in air, they are too heavy and the strobe arms would simply rotate at the clamped joints. To maneuver or carry this system in air you have to fold the arms in as shown in the photo below. However underwater the entire system weighs almost nothing, and is very easy to handle. You can hold it in place underwater with a fingertip. The strobes stay in the fully spread position with only modest pressure on the arm clamps.

Nikonos V, 15mm lens, SB104 strobes in folded "carrying" position

Wide-angle underwater photography can be stunningly beautiful, but it is by far the most difficult type of underwater image to produce. One of the reasons wide-angle underwater photos are so interesting is because, unlike other types of images, they almost always have two distinct subjects, one close and one distant, the background. Both of the subjects must be in acceptable focus and properly exposed. The extreme depth of field inherent in wide-

angle lenses helps to solve the focus problem, but the dual exposure is another matter. The close subject, often a fan, crinoid, sponge, soft coral, etc., is illuminated with artificial light from the strobes. The background subject, the water column or surface, sunburst, reef wall, kelp forest, huge school of sharks, etc., is lit with natural light from the sun. This involves two separate but related exposures, one for the strobe-lit close subject and one for the ambient-lit background. This takes considerable thought, particularly when you are trying to stay alive underwater. It is done by metering the ambient exposure for the background. That establishes the correct aperture, since the shutter speed will be set, either manually or automatically, to synch with the strobes (it will normally be 1/60, 1/125, or 1/250 sec depending on the camera). Knowing the aperture, the appropriate strobe power setting is determined based on the distance between the strobe and the close subject. The shutter speed has virtually no effect on the strobe-lit exposure. The strobe fires in about 1/30,000 of a second. If the subject or the camera is not moving excessively it doesn't matter whether the shutter is open for 1/60 or 1/250 of a second. Newer cameras can determine both exposures for you automatically, and normally they do it very well, but it has always been helpful for me knowing what is involved if I ever had to do it again manually.

Close-up or macro photography underwater is much easier technically, but it requires more skill in knowing, finding, and stalking your subjects. To overcome the problem with precise focusing on close subjects using Nikonos viewfinder cameras, some very clever people invented a system using extension tubes and framers. The extension tubes are attached between the camera and the lens, which greatly increases the focal length and decreases the minimum focus distance. The minimum focus distance on the Nikonos 35mm underwater lens, without extension tubes, is 2.75 feet (33 inches.) With extension tubes this can be reduced to less than 2 inches. A wire "framer" is attached to the bottom of the extension tube with a nut on a stud. The framer has two vertical "prongs" at precisely the minimum focus distance, separated by a distance just wider than the width of the image at that distance. This ensured that the vertical prongs of the framer did not appear in the image. Different sized framers are used with different lenses and extension tube lengths for different subject sizes and distances from the lens. Photographically, using extension tubes and framers is easy; everything is preset above water before the dive. The lens is set at the appropriate focus distance (generally infinity) and small aperture (generally f16 or f22), and the strobes are pre-aimed right at the framer. Now all you had to on the dive was to turn everything on, find a subject which would allow you to place the framer around it, and press the shutter. Whatever was right inside the framer when you released the shutter was always precisely in focus and properly exposed. Easy, right? Any subject of the right size, and which could be positioned inside of the framer, could be nicely photographed with a tube/framer system. Here's what the extension tube and framer system looked like:

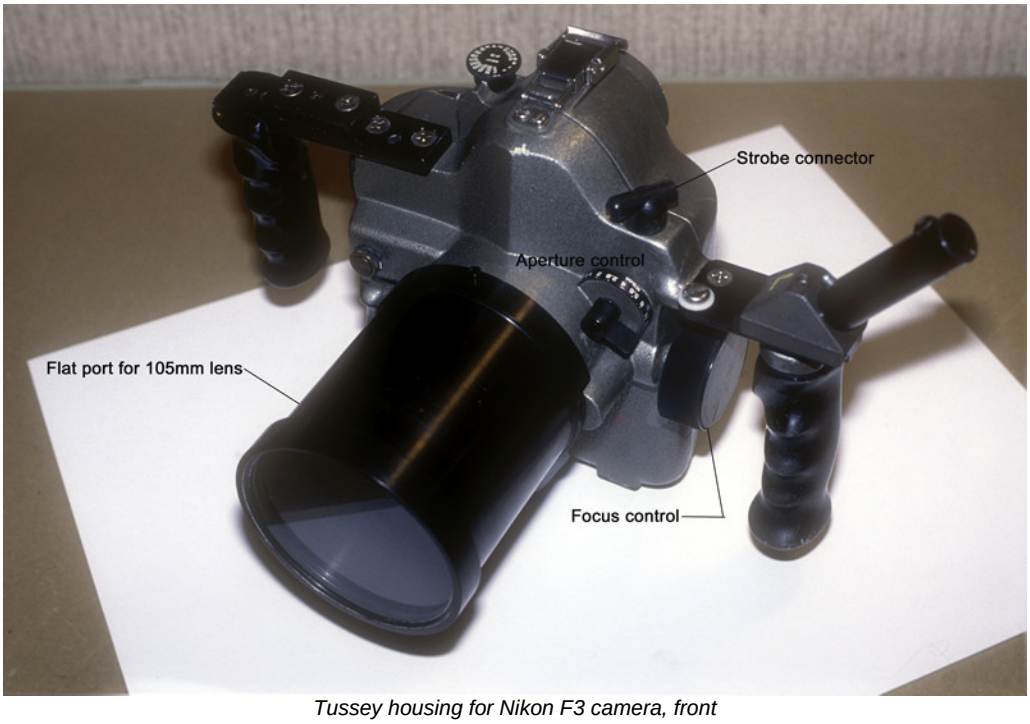
Extension tube and framer system

In the photo above, there is an extension tube between the Nikonos V body and the 35mm lens. The 3:1 framer is attached to the bottom of the tube by a stud and nut. The lens is preset at f22 and focused at infinity. That results in everything in the plane of the framer being in precise focus. The two small Ikelite 50 strobes are aimed directly at the framer. A modeling light, tremendously valuable for locating subjects in dim light, is attached to the shoe on top of the camera and pointed directly at the framer. The modeling light is the blue thing directly above the camera.

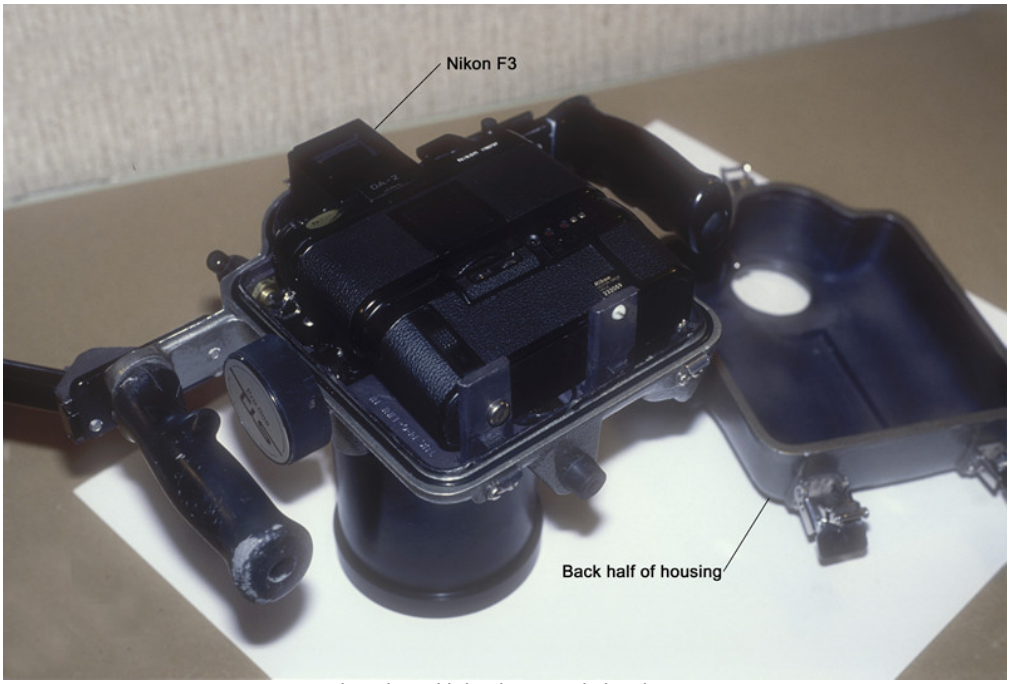
In the days when film was the only photographic media, I thought that everyone starting out in underwater photography should begin with tubes and framers. That was because every image, whatever the subject was, would at least be technically correct, i.e., anything in the framer would be properly exposed and in focus. Confidence could be built, and the photographer could start to get a feel for what water does to light. Plus, you could get some extremely good photographs with tubes and framers, as long as the subject would accept the presence of the framer. Tubes and framers have produced many publishable-quality photographs of relatively stationary and/or fearless subjects like nudibranchs, corals, anemones, and some types of fearless (or retarded) small fish. However I am not aware of any tube/framer setup that is compatible with the viewfinder “point and shoot” digital cameras that are now used underwater, so my advice about starting with tubes and framers is probably no longer valid.

The problem with tubes and framers, of course, is that not everything lets you put a framer around it. Primarily for that reason, like most “serious” underwater photographers, I eventually changed to a housed SLR system. That means a land SLR camera with interchangeable lenses, mounted inside a waterproof housing. External controls on the housing, linked internally to the actual camera controls, allowed the camera to be operated from the outside of the housing. Connections on the housing were provided for attaching

external strobes to the camera inside. The housed system I selected was a Nikon F3 camera (with attached motor drive) in an aluminum housing made by a company called Tussey. I had flat ports for the Nikon 55mm and 105mm lens, and a dome port for the wide-angle 20mm lens.



Tussey housing for Nikon F3 camera, front



Tussey housing with back opened showing camera

The F3/Tussey combination was my primary system for about five years in the late 80s and early 90s, for both close up and wide angle work. Since it did not offer autofocus or automatic TTL strobe exposure control, all of my strobe photography during that time period was done with manual settings. Because of that, I learned a tremendous amount about

artificial light exposure control which has always served me well. Every serious photographer should master manual exposure control before you set that dial to “TTL” or “Automatic” and let the camera make all the decisions.

In 1992 Nikon introduced the world’s first submersible underwater SLR camera, the Nikonos RS. “RS” stood for “**r**eflex **s**ystem,” meaning that it was a true single-lens reflex camera that could be taken underwater without a separate housing. Nikon eventually made four lenses for the RS, a 28mm, a 50mm, a 20-35mm zoom, and a 13mm fisheye. A third-party 2X teleconverter was available that could change the 50mm into a 100mm. The RS was a magnificent piece of equipment, and it was my primary, virtually my only, underwater system for about 12 years—from 1992, the year it was introduced, to 2004 when I went digital. I bought my first RS camera in 1992, the year it was introduced, and I bought another one in 1996 on the day Nikon announced they were discontinuing it. The RS system had pretty much everything the underwater photographer could want—self-contained without a housing, autofocus, automatic TTL flash exposure control, great lenses, and a huge viewfinder. So why was it a big commercial bust, marketed for only four short years?

The main reason that the RS was not a commercial success for Nikon was that it was extraordinarily expensive. The body alone sold for about $3,500, and the lenses ranged from about $1,000 for the 50mm and the 28mm, to over $3,000 for the 20-35mm zoom. As I mentioned, a third-party 2X teleconverter was sold by a German company which would convert the 50mm to a 100mm, but it was also expensive (about $1,200) and had limited availability. A full RS system, body, lenses, strobes, arms, brackets, could easily set you back $10,000, and this put the RS simply out of reach for many divers. The cost of the RS system severely limited its market.

In my opinion, another serious drawback to the RS was that Nikon never made an RS lens in the 100-105mm range, which many photographers, including me, considered a necessity for macro work. Another thing that bothered many users was the excessive underwater weight of the RS system. With strobes, arms, and brackets attached the system weighed over 4 pounds underwater. This is significant enough to affect the weight you carried on your belt. Many divers, women in particular, complained about their wrists tiring in just holding and aiming the RS. The weight never bothered me, my wrists and arms were strong enough so that this never became a factor, and in fact I considered the weight somewhat of an advantage in making the camera system more stable underwater. But the excessive weight was consistently listed as a disadvantage of the RS system.

Finally, some of the early RS camera bodies flooded. I don’t think the percentage of floods was high, but any significant flooding in a camera that expensive was unacceptable. Nikon quickly modified the hinged back and o-ring configuration to address these early floods, but the stigma of these expensive bodies flooding persisted. I never flooded one, but I know it did happen.

Nikonos RS with 28mm lens

Nikonos RS with 50mm lens

Nikonos RS with both backs open

For all of its glitches, real or perceived, the RS system worked for me. I absolutely loved it, and as I said, used it virtually exclusively for more than a decade. Which brings us to the digital photography revolution.

The whole nature of photography has now changed with the introduction and evolution of digital imaging. The advantages of digital photography are enormous, it is so much fun it should be illegal. There are, in my opinion, several things offering much less fun that ***are*** illegal. The quality of digital images is now so good that it is indistinguishable from film, and that includes looking at the images on a computer or looking at a print made from a digital image on an inkjet printer. For underwater photographers, there are two huge advantages, the most important being the ability to make virtually unlimited numbers of images on a single dive. With film, you are limited to 36 frames on a single dive, unless you take down more than one camera, and most photographers simply don't do that. With digital cameras and high-capacity storage media you can shoot several hundred high-resolution images on every dive with a single camera. With film, almost every one of my dives ended when I ran out of film. Now my dives generally end when I am low on air or I need to pee (you don't pee in a drysuit and I am one of those divers who thinks it is bad protocol, albeit feasible, to pee in a wetsuit). The second giant advantage for underwater photographers is the ability, also available to topside photographers of course, to briefly review the image immediately after you record it. Admittedly the view you get of the image in the small monitor on the camera is not exactly like looking at it on a large flat-screen computer monitor, nonetheless it can give you a lot of instant information and feedback about composition and exposure that you don't get with film, and that information is tremendously valuable.

So after 25 years of taking pictures underwater with a variety of film cameras I converted to digital in 2004. I use a Fuji S2 Pro SLR camera which accepts all my Nikon lenses and accessories, in a Subal FS2 housing (dome and flat ports) with two Sea and Sea YS-90DX strobes. I also occasionally use two Nikon SB105 strobes with this system. I use Nikon

10.5mm, 12-24mm zoom, 60mm, and 105mm lenses with the appropriate ports. I am grateful to my old friend, mentor, and world-class professional underwater photographer Marty Snyderman and to Fred Dion of Underwater Photo-Tech in Derry, New Hampshire, for all the advice they gave me about equipment. Here's what my system looks like:

Subal FS2 housing for Fuji S2 Pro digital SLR camera, dome port (photo from Subal website)

Subal housing, Fuji S2 Pro inside with Nikon 60mm lens, 2 Sea and Sea YS-90DX strobes, ready to hit the water

And finally, permit me a few closing thoughts. Underwater photography has been the most creative, and the only really *artistic* thing that I have done in my life. Certainly some of the engineering work I did was innovative and, therefore, creative. But it was creative in a scientific, heavily technical way. Photography has been my art. Unquestionably there is much engineering involved in underwater photography, and I have to admit that I always loved fiddling with the equipment, greasing o-rings, testing and setting everything up, whenever I got ready for a trip. It was almost as much fun as taking the pictures. Note that I said *almost*. I guess that's why I devoted so much time here to document the photographic equipment I have used over the years.

Underwater photography has opened my eyes to an amazing and stunningly beautiful world. A world right here on our planet, and yet we know less about it than we do about outer space. Underwater photography has led me to some of the most wonderful, fascinating places on the face of the earth, and it led me to a treasured relationship with my daughter Coleen. I wrote this so that my grandkids, and their kids…could experience some of the beautiful and amazing things I saw underwater, and read, in my own words, how I described them and felt about them. If some of this in any small way inspires them, or anyone who reads this, to become divers and underwater photographers, or just to appreciate the oceans more, this effort will have been worthwhile.