

undercurrent[®]

THE PRIVATE EXCLUSIVE GUIDE FOR SERIOUS DIVERS

March, 1977

P.O. Box 1658, Sausalito, California 94965

Cable Address: Gooddiving

Tobago, West Indies

Fine Diving for Cajoling Current Cruisers

Diving Tobago with the gang from the Blue Waters Inn, the only diver oriented operation on the island, is an experience which generates more diverse views than any spot I've ever visited. And, I've been diving for 16 years. Opinions range from "I'd go back in a minute," to "I wouldn't go there on a bet," and in between those opinions show great shades of difference. Tobago is an unpredictable, somewhat primitive, relatively difficult place to dive and there seems to be agreement on only one matter. The marine life is abundant, colorful, and friendly and at many dive spots it compares with some of the best in the world. But, unless you twist the arm of the dive guides, you may not get to the best spots.

French, grey and queen angelfish abound, larger than I have seen just about anywhere. Groupers between 50-100 lbs. are plentiful on the ocean side of Little Tobago Island. Nurse sharks--the more peaceful variety--are common in caves and under coral outcroppings. I was impressed by the gorgonia of all sizes, black coral, large, clam-like hard sponges, all the habitat of a myriad of tropicals, large barracuda carefully keeping their distance, gaping green and spotted morays and even a small octopus I spotted on our one night dive. I was annoyed by swarms of small jellyfish--they've been reported by plenty of Undercurrent readers--which hover near the surface and greeted some entries and exits with annoying pinpricks.

On my first two days I was blessed with 100+ foot visibility, but for the remainder of my week it ranged between 30-70 feet, a common range according to Undercurrent readers. Plankton caused the lower visibility, but the current also keeps things moving--including the divers. The current may surpass 3 knots and inexperienced open water or current divers may find diving here produces too much anxiety for comfort. I enjoy flying over the reef, with a guide in the lead and one (usually) bringing up the rear, but as you can imagine, the current makes photography difficult. There is always surface chop and sometimes large swells and a few divers who left their dramamine at home turned green at the gills.

As an experienced diver, I was somewhat disappointed with the diving restrictions. In the current a good diver's ability is always being tested, but I am still disappointed when nearly every dive site is selected to meet the standards of the inexperienced divers on board. That's what happened in Tobago. One night dive was outstanding, but we were restricted to 30 minutes in 30 feet of water, almost a waste of time except for those who had never been down at night.

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Bob Wagner is presently the divemaster. He expects to remain until June. Bob is a well qualified, safety conscious diver, familiar with the dive sites and the current. He is ably assisted by two native brothers, Danny and Redmond Melville, and Ron DosRamos, the Blue Waters Inn Manager. Prior to each dive (there are two/day at 10:30 or 2:30, give or take an hour) the guides brief the divers on what to look for at the dive site, the current, the depths, and the dive plan. Boat rides are generally ten minutes or so, but to the best sites (e.g., Little Tobago Island) the ride itself may take half an hour. To get to the better sites the guides may have to be wheedled and cajoled. Because some of the better sites are more difficult diving, the problem could be solved by having a third operable boat for experienced divers. Wagner concurs, but whether the problem will be solved remains to be seen. Dividing up boats according to diver skills might also help.

Actually, the shop possesses three boats--two 17' Boston Whalers and a 27' locally built pirogue--but only two outboard motors. The boats are without ladders for easy entry, an annoyance in flat water and a hazard in water with chop and current. The excuse can only be bad management. Otherwise, the well-organized operation demonstrates good management. Each diver has a personal storage area for gear, near the fresh water tanks and wooden drying racks. The shop uses fifty U.S. Divers aluminum tanks, and supporting gear is in fine shape. Regulators can be rented and so can snorkeling gear. Snorkeling from the hotel beach is terrific! No spare parts or repair service is available, so come fully prepared. Surprisingly, the shop has a large, two man recompression chamber with telephone communications, but not surprisingly, the chamber is out of service and I couldn't find out when it would be repaired.

The Blue Waters Hotel is an isolated retreat without frills. Six of its twelve units are without hot water and all have spartan decor: two or three single beds, no chairs, a chest of drawers and a wardrobe, and a bathroom with shower. The rooms are clean and towels and linen are changed daily, but keep your suitcase closed so the ubiquitous cockroach can't gain a new home. Although I found my bed a little uncomfortable, after two dives, sunshine, cocktail hour and dinner, the gentle waves breaking 70 feet from my doorstep was the only sleeping pill I needed.

Food is well prepared and tasty, though nothing special. Portions were a bit small and seconds seldom available. Unfortunately, fresh fish and fruit were served only a couple of times. The bar is small and not well stocked, so to get your preference, pick up your own at the duty free shop en route to Trinidad. For entertainment, there are two sunfish sailboats, shuffle board court, darts and ping pong, and a tennis court in good condition, but with the fence down at one end. No sundries are available at the hotel, so bring everything you need. Hotel managers Ron and Ailsa are delightful people who went out of their way to make the guests happy. I found the natives friendly, although others have reported difficulty. Hiking through the jungle-like vegetation and along the coastline is enjoyable. The few snakes are not poisonous and the lizards are harmless. For limited night-life, it's an hour to town and 1½ hours to the tourist area. Rental cars can be delivered to the hotel.

Would I return? I liked Tobago and rate it among the best in Caribbean diving. Marine life in the best spots rates with the Great Barrier Reef and Fiji, but you have to push to get to those spots and you may not succeed as often as you like. Teach/Tour (Box 390, Nazareth, PA 18064) runs \$265 packages (double occupancy, 8 days, 7 nights, 2 meals, 10 dives) plus airfare. I've used them twice and have been dissatisfied with their ticketing operation, but given the speculative nature of Caribbean dive travel, I recommend their hotel/dive package rather than going it

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alone. If the dive operation is closed, Teach/Tour will be the only ones to know about it. (S.C., 1/15)

Diving for Dollars:

Watching your portfolio go up while you go down.

Just a year ago, we suggested a way *Undercurrent* subscribers might actually *make* some money on diving, or at least make back some of their diving dollars spent. If the idea of profiting from your favorite sport by buying stock in a company with a stake in the diving industry offends you—read no further—because here we go again.

The suggestions we made last year have proved to be rather good ones, or chances are you would not have heard further from us on the subject. Would you expect to hear from your nephew, Mortimer, the stockbroker, who touted you into Water Wonder, Inc., the hot little California lawn sprinkler company that went public just before the drought began?

The company we featured last March was Great American Industries. It was then trading on the American Stock Exchange at $4 \frac{3}{8}$, has since advanced to $6 \frac{7}{8}$, and now sells at 6. If you took a plunge with 1000 shares, a mere \$4500, you could have surfaced with almost \$7000, enough for a nice Caribbean holiday. Even 100 shares could have bought you a 15-year subscription to *Undercurrent*. The company's net income was up 47 per cent in the first nine months of 1976, the most recent reporting period.

Great American is relatively small among listed publicly owned companies, that is, those which sell stock to the public at large through stock exchanges. It had annual revenues last year of about \$60 million, partly reflecting recent acquisitions which will boost sales further in 1977. The company owns New England Divers retail shops, with outlets in Massachusetts, Florida, California and Washington. W. J. Fleming, Executive Vice-President, tells us that additional outlets may be opened as opportunities arise. Parkway Fabricators, another Great American subsidiary, designs and manufactures wet and dry suits for sport and commercial diving. It also produces the Poseidon Regulator. Great American's Underwater Industries, Inc. sells equipment and sports apparel in the Virgin Islands and Puerto Rico, and furnishes scuba diving services to resort hotels. Expansion of Underwater Industries seems as though it is being aggressively pursued. In our travels through the Caribbean we have met more than one charter operator who has been wooed. Finally, the subsidiary Rubatex Corp. manufactures skin diving material from closed cell rubber, as well as a large variety and volume of articles unrelated to diving.

All this does not mean that scuba diving is the principal activity of Great American. Other company activities are of much greater importance, and will be-

come more so, reflecting acquisitions in real estate, furniture cushioning and containers—all far afield from diving. What we found last year, however, remains true: it is not possible to find a "pure play" in the diving industry among publicly owned companies. The diver/investor must settle for what is available.

When we asked the Executive Vice President for an earnings estimate, we found him to be as wary of making predictions as you and I might be about having close contact with an amorous octopus. Did we luck out last year, or does Great American continue to have a bright future? Ask Mortimer.

About AMF:

The other company we wrote about most was AMF, Inc., the General Motors of the leisure field. Divers know the name AMF Swimmaster (fins, masks, wet suits), and most of us recognize names like Head Skis, Harley-Davidson motorcycles and Hatteras yachts. We know AMF to be preeminent in bowling and an important factor in athletic equipment under the Voit label.

Last March AMF was trading on the New York Stock Exchange (it is a company with over \$1 billion in sales) at 21. The stock rose to $24 \frac{3}{8}$, and now sells for 22½. Not spectacular, but not bad either, considering the 6 per cent return the dividend afforded, and how most stocks performed in the past year. Earnings for 1976 rose 21 per cent and prospects for 1977 appear good. While diving is a small part of AMF's sales, the company's investment grade stock offers a unique opportunity to participate in the broadest possible spectrum of the leisure field.

... And Two More

Two new companies have "gone public" since our last exploration into the world of diving investments. Neither yet participates in sport diving, but the fortunes of both are totally related to underwater activity.

The first, Oceaneering International, is a company with revenues of over \$50 million. It provides diving and subsea construction services to the offshore oil and gas industry. It furnishes divers, systems, and equipment, as well as maintenance and repair facilities and oceanographic survey services. Oceaneering also operates a diver training facility. Its operations are conducted in 24 foreign countries. Although its first stock issue was underwritten by the prestigious Lehman Brothers and White Weld & Co. at \$12 a share, the following year, 1976, the stock itself took a deep

dive. Earnings had dropped 47 per cent, for reasons management considers to be non-recurrent. The stock now sells for 7¼ and its supporters believe it affords substantial recovery possibilities from this level.

Tetra Tech, Inc., brought to the public market last November at 8, has fared much better, and now sells for 9½. The company develops, manufactures and sells underwater television systems, instruments, and remote controlled vehicles for the offshore oil, construction and utility industries. It also engages in water resources and environmental engineering. If its excellent pre-public record is indicative of its future, and if the potential in the field is as great as some contend, Tetra Tech might prove to be an excellent speculation.

Private Companies

A privately held company, Farallon Industries, manufactures almost a full line of sports diving equipment at Belmont, California. The company, owned by Dr. Norman Moore, an engineer who is said to have been one of the developers of the microwave oven, has been in business for 10 years. It does an annual volume of about \$3 million, according to Mario Valenzuela, Marketing Vice-President. The company is broadening its product line to include underwater communications equipment and unrelated to diving—into the security and police equipment market.

A much newer company, Tekna, Inc., located only a few miles away in Menlo Park, was founded in March of 1976 and incorporated last August. Tekna makes masks, snorkels, rechargeable lights, and related pro-

ducts and expects to do a volume of \$500,000 for its fiscal year ending July 31. Its president, Ralph Shamlan, was one of the principals in establishing Farallon. He is no stranger to the ways of sophisticated entrepreneurs. He foresees substantial growth, and believes the company will one day qualify to "go public."

Our conversations with officers of both Farallon and Tekna left us with the impression that each would welcome additional investors to finance their expected growth. We divers are a venturesome lot; venture capitalists among us might wish to learn more about these companies by contacting them directly. Or, for that matter, any of the other companies manufacturing dive gear.

There you have it—a range of investment possibilities from large listed companies to newer ones whose shares trade in the "over-the-counter" market, to companies which have yet to bloom as public investment vehicles. Remember, please, that *Undercurrent* has tried to provide the best information available but cannot vouch for its accuracy or completeness. Finding your way to profitable investments can sometimes be about as difficult as finding which way is up on a night dive when your light goes out. *Up* is the direction we all want our investments to go—and it's what we wish for you if you decide to invest in diving.

Correspondent Albert Haas, Jr., a vacation snorkeler, is a financial columnist and contributing editor for *San Francisco Magazine*. A former senior vice president of Sutro and Co., the brokerage firm, he recently authored "Getting Eaten Alive in the Options Game" for the *Sunday New York Times*.

Ed Brawley, NASDS et al:

The beef goes on.

As we reported in the October, 1976 *Undercurrent*, in 1974 Ed Brawley, owner and operator of the Professional Divers Instructional College in Monterey, California, filed suit against John Gaffney, Executive Director of NASDS. In mid August, 1976, the Northern California District Court found Gaffney guilty of taking and using Brawley's course material without permission—that is, copyright infringement.

Since our article was printed, Judge Albert Wollenberg, last November 24, issued an injunction against Gaffney and NASDS, prohibiting both from using, in any manner, material from Brawley's Instructor's Guide and from portions of his *Blue Book*.

Gaffney, of course, is going to appeal. "Look," he said in a telephone interview with *Undercurrent*, "Ed Brawley thinks he owns the ocean. I've been teaching since 1962 and the appeal is just automatic." Gaffney doesn't know the grounds on which his appeal will be based nor the timing of the appeal. "I'm leaving that up to my lawyers," he contended.

Of the first story, Gaffney said it was accurate—but "you overlooked one important thing. Brawley was

Treasurer of NASDS during the time he claimed we took his material without permission."

Gaffney seems to believe that the material is as much his as Brawley's, but when asked whether this would be grounds for appeal, he reiterated that it was up to his lawyers.

Brawley expects to recover a substantial sum of money from the suit, but he's also aware that if Gaffney appeals, it might be years before the final settlement is made. He continues to believe that others, too, have infringed upon his copyright. Last fall he threatened to bring suit against PADI and recently he settled out of court for what he says is an "adequate sum;" to Brawley, that's proof of infringement.

Jim Hall, Training Facility Director of PADI, believes Brawley would have lost his suit, but that defending the company against a nuisance suit would cost far more than a settlement. According to Hall, the full cost of the settlement will be somewhere around \$1000, a pittance compared to a full-blown legal defense. To PADI, the settlement was merely good business and no admission of copyright infringement.

In the meantime, Gaffney is developing a new

NASDS training manual. Although two sources claimed Gaffney's new manual was simply a rewrite of the old manual to avoid copyright infringement, Gaffney scoffs at this. "We've been developing this for 16 months," he said, adding that 10 of his top instructors from around the country were brought into NASDS headquarters in November to review it carefully and add the final touches. Gaffney is proud of the effort. He says several innovations have been developed, including new "Safe Scuba Tables" which a student can learn in 15 minutes, as opposed to the two hours it can take now to master the Navy tables.

Brawley seems most interested in developing and maintaining his program to train instructors (three months in Monterey for \$3000). He believes that stores easily recoup their costs by the increased instructional and sales skill of the people he graduates. He claims that New England Divers, a first-class example of successful retail outlets, is converting all of its stores to Brawley-trained staff.

Apparently, Brawley does not intend to begin his own basic certification school, but he is highly critical of most beginning certification courses. He claims that leaders of the industry told him to "shut up and show a united front" during the last couple of years when the industry feared government intervention. Now that threat has passed and he says he's ready to speak out. Brawley contends that he doesn't believe in long classroom sessions on Boyle's Law, on making people take lap after lap in a pool to demonstrate or develop stamina, or lengthy classroom skull sessions. Rather, he believes one needs to develop and demonstrate appropriate skills for diving and is only then ready for certification. Brawley believes this requires at least five open water dives, it demands training novices when they're very tired or even nearing exhaustion ("That's when the diver gets himself in trouble and needs to learn how to handle it.") and practicing emergency procedures, including emergency ascent. He claims that others don't want to teach it because they are afraid of the liability, but he argues that teaching emergency ascent is a must to create the confident diver.

The effort Brawley put into development of his own emergency ascent procedures indicates why he protects his manual. Brawley said that in his teaching he found that a diver embolized about one out of every 1000 ascents when blowing bubbles. He said that with careful research he determined that blowing too hard can trap air and cause an embolism. To overcome the problem he said he developed a humming technique for exhaling while ascending. Since then he says he has had no cases of embolism. Brawley wants his techniques to be taught, but when they're written into the manuals of other training organizations, he wants to be paid for them.

Brawley himself is not going into the certifying business, but an associate of his, who helped him develop his training procedures in the 1960s, has just announced a new certifying agency based on the principles she and Brawley developed. Jean Gregor and her

business partner, Rich Gallagher, are now organizing NAUTIC International for diver certification.

If not identical, the training philosophies of Brawley and Gregor are indeed very similar. NAUTIC's program will emphasize skill attainment through five levels of training. The goal will be for the student to pass each level on five open water dives. If the student passes, he moves on to the next level on the next dive. If he fails, he must repeat until he passes. Each repeat session costs an additional fee.

The NAUTIC Philosophy, according to Gregor, is consistent with philosophies evolving throughout all education. There is little room for instructor evaluation and judgement. The instructor is a teacher, not a judge. Either the student performs the required skill or he works until he does. Only then does he move to the next level of performance.

Gregor doesn't believe other agencies adequately emphasize this kind of programmed approach. Students learn skills, she says, but they don't pass through achievement levels and there is too much room for the personal views of the instructors. For example, she says, some instructors for no reason force women out of training, while others may let them pass too easily. By permitting too much latitude for instructor judgement, people who should not be diving receive their certification because of the good will of the instructor.

Gregor says the student will clearly know the skills he must demonstrate. Upon completion, the instructor will have to indicate, in writing, that the student has demonstrated each skill. The result, according to Gregor, will be highly trained divers ready to face any situation. Both Gregor and Brawley believe that with full skills divers are far more likely to continue diving because they are confident they can handle themselves. That means more divers and, ultimately, an industry which is economically healthy.

Does this sound good? Sure it does, but other people who run agencies just shake their heads. Most of them believe their programs differ little from Gregor's dream. They believe their beginners demonstrate skills and become solid divers. Open water training, they believe, is critical. But, they also believe people from landlocked states should be able to be certified.

A problem with existing certification and one sure to face NAUTIC is, as PADI's Jim Hall says, the inability of a national agency to control its instructors. Hall says with thousands of instructors around the country, the only way quality control could be vigorously enforced would be through employing field representatives whose salaries and expenses would force the cost of certification so high that no one would learn to dive. NAUTIC might work locally, the critics believe, but once an attempt is made to expand, the concept will inevitably break down and poor instructors will certify those who shouldn't be certified. Existing agencies are doing all they can to solve the problem and no one knows what NAUTIC can do that's different.

Gregor is not deterred and is vigorously at work on the NAUTIC instructor manual which will be ready in

draft form around the first of May, but PADI, NAUI and NASDS also have new manuals completed or underway.

Whether NAUTIC develops as the Harvard of the diving schools remains to be seen. But what is clear is that should one more training organization of any size

emerge, something will have to give. Over the last three years, the number of divers being certified has declined. Should that trend continue, there might not be enough porridge for all the bowls. But when the fight is carried to the dinner table, it might be a little louder this time, because there may not be enough to go around.

Working Your Way Up the River:

Devices and techniques for murky river diving.

A majority of American divers are not so fortunate to live within an easy commute of the fascinations of ocean diving. But many inland divers have no complaints because they have experienced the unrivaled thrills and excitement of river diving.

Proper river diving techniques make just about any river conquerable and once a diver learns to work a river, he has opened new diving vistas. Consider the possibilities of joining a school of salmon heading up stream; or searching the bottom for antique bottles, Indian and Civil War artifacts and other historic pieces. Remember, too, that unlike the situation at many ocean sites, you may be the first person ever to scuba through the river. You can search for lost items, which might range from overturned canoes to fishing rods. Or you could help police in searching for discarded weapons or clues to crimes. The opportunities are limitless, but before a diver tackles his favorite river, he ought to be as well prepared as a cave diver. The challenge is indeed as great.

Devices and Techniques

Unfortunately, clear rivers with mild currents are relatively scarce and a scuba diver, especially one who dives for hire, may find himself more often in swift, turbid waters than in clear, tranquil ones. Such conditions may overwhelm a diver who is unprepared for the incessant currents that exhaust his strength and the blinding turbidity that leaves him disoriented and lost before he reaches the river bottom.

Heavy turbidity and strong currents are surmountable obstacles, and a diver in reasonably good physical condition can soon learn to maintain his position in the current, with both hands free to search or work. He can learn to move forward or sideways over a rocky river bottom, in currents much too swift to swim against, and to search the river bottom rapidly and with little effort. He can do all of these things and more, in an efficient way that saves his energy and conserves his air supply.

The devices described below were designed by the author and a cohort, J. Douglas Thompson (now of Clearbrook, Minnesota) during an ecological investigation of the Susquehanna River in Pennsylvania. Techniques that are described here were developed during the course of the study and were new to us, although some of them may have already been in practice elsewhere. Most of our studies were conducted in waters less than 5 meters (16 feet) deep, but there is no reason to believe that the devices and techniques we used would not be suitable for deeper rivers.

Reaching the River Bottom

In a river too large and deep for wading, a diver is likely to work from a pum or other small boat anchored in the dive area. In the Susquehanna we quickly discovered that a diver cannot merely jump over the gunwale and swim to the bottom, even in relatively shallow water. The strong current sweeps the diver downstream as he descends, causing him to become disoriented and lost in the murky water, even before he reaches the bottom. It is futile for the diver to return to the surface in an attempt to reorient himself, for the current merely sweeps him farther down the river, more out of position.

We found that a diver could best reach the bottom by using an anchor with a line at least six meters long trailing from it. A handle, like those used by water skiers, can be placed on the end of the rope.

After the diver has "dropped" his anchor slightly upstream from the dive area, he descends to the river bottom while holding onto the anchor line, allowing gravity and the river's current to do all of the work. The diver has merely to ride along. He can slow his descent by raising his head, allowing the current to lift him upward, or speed his descent by lowering his head, causing the current to force him down.

The diver can also descend to the bottom by pulling himself headfirst, hand-over-hand, along the rope anchoring the boat. Such a descent is not recommended, for it obligates the diver to pull himself forward through the strongest current, often with his body improperly aligned with those currents. Descending the boat's anchor rope, therefore, is a needless expenditure of energy. The successful river diver must learn to save his energy for essential tasks, rather than squandering it. A diver who arrives at the river bottom

The author, William F. Gale, is the Senior Aquatic Biologist for Ichthyological Associates, Inc., a consulting firm. Dr. Gale has been studying the biology of Pennsylvania's Susquehanna River since 1971 and developed the techniques described in the article to aid his studies. More information about the devices may be obtained from Aquatic Specialties, PO Box 65, Berwick, PA 18603.

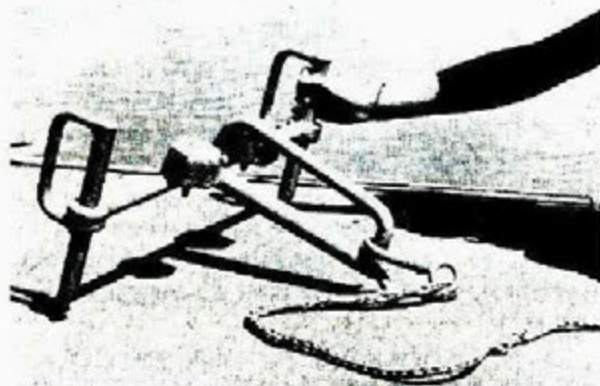
out of breath is off to a bad, perhaps even hazardous, start. Such a diver is likely to tire long before the job is done, and might easily draw the erroneous conclusion that he has faced an impossible situation.

The river diver must be both self-reliant and cautious. Above all, he should remember that in a turbid river he is, for all practical purposes, alone. If he gets into trouble, he may be unable to signal his distress. Even if he can make his plight known, his buddy may be unable to locate him in the murky water in time to help. A river diver should test all new devices and techniques in shallow water before using them in deep water. Of course, a diver will need more weight to submerge in currents than in quiet water. A diver in a wet suit with one air tank, for example, may require a weight belt with 25 kilograms (55 pounds) or more. Obviously, one should determine how much weight will be needed in the river channel before leaving the shallow water near shore.

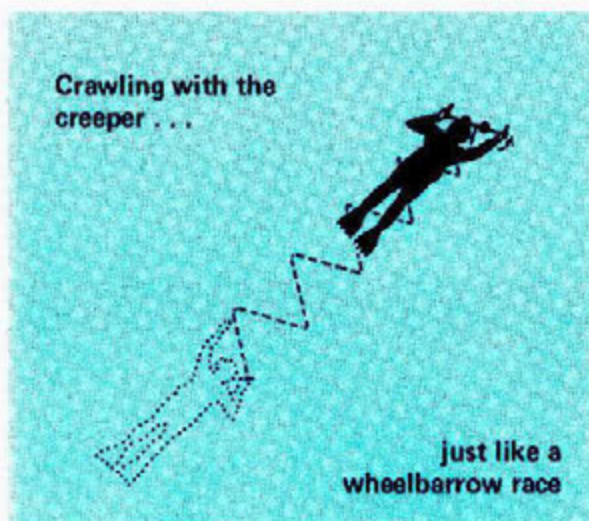
Moving Across the River Bottom

Regardless of the brand of fins a diver wears and the amount of kick he thinks he can generate, a prolonged swim upstream, against strong currents, is impossible. Just to remain stationary may require him to keep his head down, out of the current, while simultaneously hugging his body against the river bottom. In such a position it is virtually impossible to accomplish the simplest task.

It was our inability to move across the rocky bottom of the Susquehanna that prompted us to design and build the "creeper." The simple device opened new dimensions in our study. For the first time we could move across the river bottom upstream, downstream, or sideways at will.



The creeper proved as simple to use as it was to construct. The diver advances by lifting and moving the corners of the creeper forward in alternate turns (see drawing). To move backwards he has only to reverse the procedure. The creeper can also double as an anchor and, when not in use for locomotion, its enclosed handles become convenient attachment points for items that might be swept away by the current. A long line trained from the creeper's center handle makes a handy reference line by which the diver can keep track of his position in murky waters.

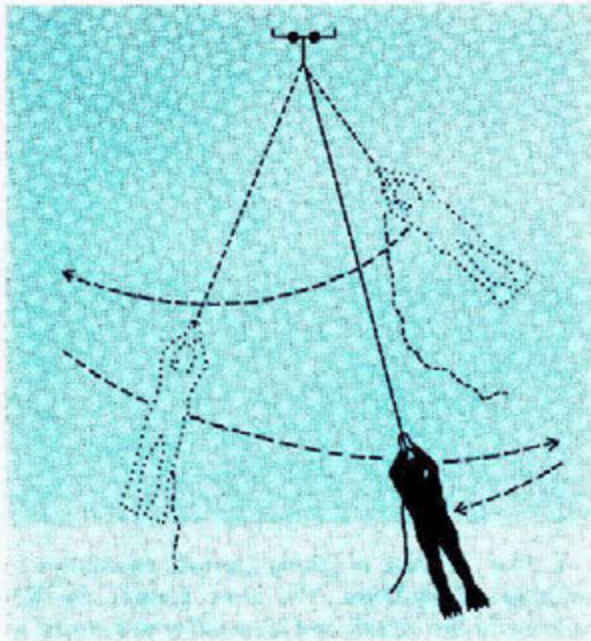


A diver working in strong currents encounters a multitude of problems. The more pressing are his tendency to tire quickly and his inability to maintain a constant position in a way that leaves both hands free to work. The diver can partially solve both problems by attaching himself to underwater objects. Anchored in this way, he can rest for a few minutes while expending minimal additional energy, or he can work with both hands. The diver, however, needs to be able to free himself quickly and effortlessly, especially in hazardous situations. This problem can be solved with a simple pair of *vise-grip pliers*. The pliers provide the diver with a quick, reliable way of attaching himself to a variety of underwater objects. The pliers' adjustable jaws can be clamped onto a "body line," to the creeper or to a variety of other gear the diver may be using.

The pliers can be used in two ways. Normally they are attached to the end of a cord, about 70 cm long, which has a large clip on the other end, to fasten to a ring on the diver's weight belt. Occasionally the diver may wish to use a longer cord for greater mobility, but if he does so, he is then too far from the pliers to release them quickly should his safety require it. In this situation, the diver has only to reverse the relative positions of the clip and the pliers. He attaches the clip to the object being used as an anchor and clamps the pliers onto the ring on his belt. When the pliers are not in use, they can have the retainer cord wrapped around them lengthwise, and can then be snapped to the ring on the diver's belt. In this position the pliers are out of the way but easily reached if needed.

Relocating Objects on the River Bottom

The most important thing to remember when an underwater object is to be *relocated* is to make certain that the boat operator can return the diver to the same general area where the object is located. This can be done most easily by lining up pairs of reference points (trees, houses and other landmarks) on each shore. At least three pairs of points should be used and their locations and descriptions recorded in detail in the diver's log.



After the diver reaches the general vicinity of the object, he can search large areas of the river bottom in relatively little time by swinging in widening arcs from a body line attached to heavy pivotal objects, such as an anchor, or the creeper. The diver can use his body like a rudder, allowing the current to force him across the river bottom in alternating directions. When initiating the search, the diver has slack in the body line and swims to the right (or left) until the line becomes taut. He then turns onto his right side, grasps the line with his right hand (both hands are needed in very strong currents) and stiffens his body, turning it at an oblique angle, so that the current sweeps him rapidly to the left. As his arc slows, he assumes a conventional swimming position and swims upstream and shoreward. When swimming against the current becomes difficult, he shifts the line to his left hand, turns on his left side and again stiffens his body obliquely to the current, to begin his arc to the right. As he arcs across the bottom, he allows himself to slip backwards along the line, gradually making larger and larger arcs. The size of his arc depends upon river velocity as well as line length. Large arcs are made in slow currents, because the diver can swim a considerable distance upstream after his momentum wanes. Only small arcs are possible in very strong currents, but they are made with greater speed.

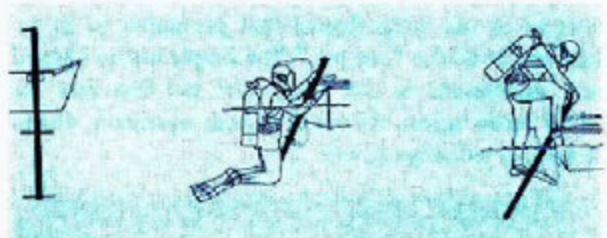
If the diver has not found the object he is hunting by the time he reaches the end of the body line, he must return to the creeper upstream by swimming and pulling himself hand-over-hand along the line (a fairly heavy rope with knots at intervals of about one-half meter makes an ideal body line). The creeper can then be moved to either side and the search process re-

peated. The search method is also helpful in finding new objects. A diver assisting the police in a search for weapons or drowning victims can use the method to cover large sections of river bottom systematically and in a minimum of time.

In turbid water a diver may pass near the object he is hunting without seeing it. Relocation of an underwater object, large or small, can be greatly simplified by trailing a long marker rope from it, or from a stake driven into the river bottom close by. A non-buoyant rope need not be weighted on the downstream end to keep it from floating to the surface, where it would reveal the object's location and catch drifting debris. The diver can relocate the marker rope, even in total darkness, by dragging one hand along the substrate as he arcs across the river bottom.

Resurfacing and Reentering the Boat

Resurfacing is one of the diver's easier tasks since he has only to inflate his vest partly and hold on to the body line. On the other hand, reentering the boat when it is anchored is a formidable task, even for a muscular diver. Conventional ladders, designed for large boats with high gunwales, function poorly on small boats with low gunwales. They hang too close to the sides of the boat to provide the diver with sufficient toe space, even if they can be held stationary, and the rungs are closed on both sides, thereby preventing the diver from placing his rubber fins on them.



At the start of our study, we had little choice but to crawl over the gunwale, like a generation of divers before us. This is no small task in strong currents that sweep the heavily laden diver's feet out from under him. To make matters worse, when the diver at last makes it out of the water, he nearly always tumbles head first in a gasping, tangled heap into the bottom of the boat, a hazard to the diver, his companions and his gear.

Indeed, river diving can be exciting, rewarding and profitable. But, the wise river diver prepares himself carefully for the venture. Our devices have served us well for hundreds of dives in our biological sampling program in the Susquehanna River. And, without them, our task would have been impossible. We hope these designs can help you on your first, or next, venture up the river. It's quite a trip.

Correspondents located strategically in the major diving areas of the world, as well as on all coasts and major inland waters of the continental United States.

The editors welcome comments, suggestions and manuscripts from the readers of Undercurrent.