Feature Article

LIFE ON A STREAM BOTTOM

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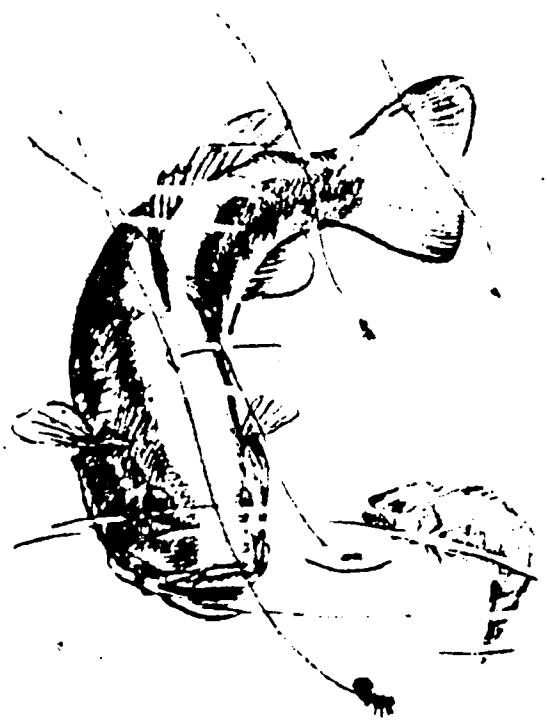


TENNYSON'S stream sings, "Men may come and men may go, but I go on forever," even though this is not the case if we see the whole picture.

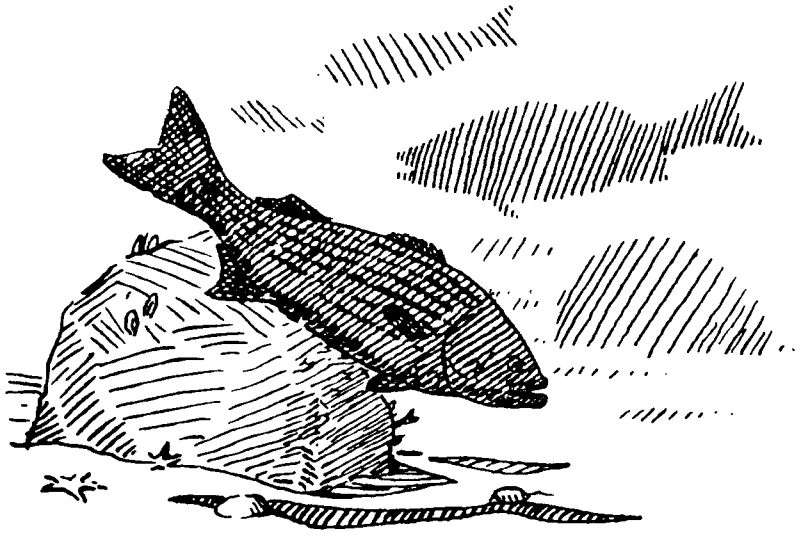
A fisherman wakes up when he refers to "here and there a lusty trout and here and there a grayling," whether he ever saw a grayling or not. In Tennyson's "The Brook," we find stimulating reference to a "sudden sally," a "foamy flake," a "brimming river," a "silver water break about the golden gravel." In fact, he runs the gamut of picturesque and accurate description of what happens over a stream bottom where our subject goes slipping, sliding, glooming and glancing or "loitering around the cresses."

Other poets enrich our vocabulary by mentioning "ancient waterstairs," "the happy brook's little plups," and one even lets down the bars when he refers to a flowing liquid as "gurgle." My, my. One of the least known, but I think the best, is Dana Burnet's "Life" in which he builds a picture of life around a little road that obviously followed a watercourse and "laughed and left you there" when he reached the source.

It is with the greatest regret that I leave this story for more mundane considerations. Also, I ignore the whole world of excitement recorded by the military, by explorers, by exponents of many disciplines and by political chicanery associated with the final path of Route 66. The bottoms of streams make history, economics, art, failures and successes; but we must stick to natural history says the boss so "here goes," say I.

Stream Flies

In earliest spring, when the ice goes out with the flood, the ground near a stream bottom and the associated vegetation may be deeply masked by blankets of living, crawling stone flies. There are possibly a thousand kinds of these creatures so almost any one will do. They have spent the first two or three years of their lives completely submerged in swiftly-flowing water. Now they come out on land. Usually, without waiting for a pupal stage that one is inclined to expect, they hasten on to the more fundamental and interesting phases of life. They mate and a fertilized female may lay up to 1,000 eggs either in or near the water where she has spent her youth. These members of the new generation may spend over five years reaching a stage where they can go on a spree "doing what comes naturally." Part of the ceremony of this stage of a stone fly's life may well be flying *UPSTREAM* gaining lost ground that was part of their early history. The nymphs crawled about under water through vegetation feeding largely on small animals found there. During this period, they breathed air extracted from the water, generally through little pads of gills that lie close to the bases of the legs. As adults, they may be attracted to lights and great numbers may form huge clouds over cities. Others may be gobbled up by hungry trout or, at-



tached to hooks, may help other trout to their "reward" in a creel. This is particularly likely if the fisherman collects his adults where they are leaving the water and takes them upstream to where trout are just waiting to give them a welcome. I spent one of the most glorious days of my life doing this in the Logan River in Utah. The adult stone flies may be a number of inches long and may appear to be vicious but they are harmless to man. Their relatives, the dobson flies, which usually emerge later in the year and which make superior bass and perch bait, may give a vicious pinch to a hand if given the opportunity. Adult male dobson flies may have a 5-inch wing spread and enormous jaws useful primarily in effecting a satisfactory mating. Sometimes the eggs are laid in inch-wide blotches on supports usually over the water. When hatched, the eggs or young drop into the water and may spend up to 35 months there until they reach maturity. While fish like to eat the immature dobson flies, the immature dobsons may eat fish completing an interesting bargain, the winner of which is any man's guess as is so often the case in zoological matters. Other insects related to the dobson fly include fish flies and alder flies.

May fly nymphs may swarm over submerged rocks on stream bottoms in fabulous numbers. They usually show two "tails" and bear their gills commonly along the sides of the abdomen. They feed voraciously on the slimes on rocks under water and serve primarily in turning this vegetation into animal food. Their adult stages live for only a day, but the life cycle may take a month or so. The adult stage may "hatch" quickly and fish may go crazy harvesting them. Many artificial trout flies are made to imitate them. In spite of what Benjamin Franklin wrote about May flies completing a generation in a day there are usually only one or two generations a year. There are some 500 species found in the United States. Types of recognized nymphs include the climbers, the sprawlers, the burrowers and in swift water, the free rangers. Some species may inhabit trash, silt, and vegetation. The nymphs are almost wholly plant eaters. They require a suitable and good aeration. They are often the most abundant and suitable of trout foods. The adults eat little or nothing. The speed of respiration may be recorded by the movement of the gills and may vary conspicuously with activity. May flies belong to the Ephemeridae and have a world-wide distribution. Mating occurs spectacularly during flight and the eggs become stuck to convenient objects. After a flight, the dead bodies may pile up to a depth of a foot or more, may make pavements slippery and become traffic hazards. Change to the final adult form may be effected in a few seconds.

The Odonata include the dragon flies and the damsel flies some of which are 2 inches long. Some fossil dragon flies had bodies up to 15 inches long and wingspreads of 30 inches. The nymphs of some dragon flies can burrow out of sight in a few seconds. The nymphs capture their prey by various means but the ultimate act usually consists of a grasping act put on by the jointed lower jaw which can be thrust ahead with lightning speed. Damsel fly nymphs move through the water commonly by a sideways wriggling movement. The eggs of members of the group may be dropped into the water in flight or inserted with care into slits cut in plant tissue sometimes in deep water compared to the size of the insects. Both adults and nymphs feed on animals captured alive usually in pursuit. They are effective destroyers of many insect pests such as mosquitoes. Not a few of the nymphs burrow in stream bottoms thus qualifying for our consideration here. They themselves are harmless to man. Many of them are among the most beautiful of insects at rest or in flight. It is easy to understand how many students become fanatically enthusiastic about them. Some dragonfly nymphs may become pests in fish hatcheries but they are rarely present in sufficient numbers to cause serious trouble.

Dragon flies hold their wings outwardly horizontal when at rest while the damsel flies hold them folded parallel to the abdomen or tilted upward.

Frequently in looking into shallow waters you may see what look like bunches of plant material moving upstream over the bottom. Look closely and you may see that at one end there are some legs causing the movement. At other times you may find little stone houses carefully put together but open at one end and with the legs of the resident insect sticking out. The stones, of course, weigh the house down so that the insect may remain in place in moving water and merely catch a meal as it goes by. In some cases, the host insect may spin a little net which opens upstream and catches things that drift into the net. The insect when it wants a meal merely eats what has drifted into its net. When you clean your trout you may find these insect houses in the alimentary canal of the trout and you may use them in a way to tell whether your trout was feeding in swift water or in still.

Adult caddis flies or Trichoptera are usually nocturnal. The adults do not live in the water. The eggs may appear in jelly-like rings attached to submerged trash. There may be one or two genera-

tions of caddis flies a year. The adults commonly flock about lights and when dead get blown into huge piles. The fine hairs may blow about and cause a sort of hay fever at times. The immature stages are often so abundant that they may constitute a considerable portion of trout food where they are found.

The bodies of larval caddis flies are delicate, juicy morsels for fish and it is well that they are usually protected by plant or stony covers. The head bears small antennae, jaws necessary for eating and legs useful in holding prey or in changing position when needed. The protecting case may either be portable or fixed. Each species has its own type of case which may assist one in making desired identification even under water.

Other Insect Groups

Other insect groups represented on the beds of streams are the beetles, as adults, that crawl about on the bottom, the water pennies (psephenids) or riffle beetles that cling to rock surfaces in swift water and the diving beetles that are usually black and brown and carry a bubble of air at their rear when under water. There are the scavenger beetles whose under surface is usually covered with a film of glistening air, the small crawling water beetles or haliplids that feed on the contents of the cells of submerged algae and when submerged carry an air supply in a bubble under water.

Additional and conspicuous aquatic insects that often cover the bottoms of waterways in the summer or fall or even late spring include the black flies, the midges and the deer flies, some of which are serious pests to outdoors folk, the no-see-ums that enter homes without knocking and get their share of the blood of the residents. There are the netwinged midges that cling to submerged rocks in their early stages, the crane flies which appear as huge but harmless mosquitoes but whose larvae make superior bait, the midges and the biting midges, the deer flies who attack humans mercilessly and painfully and the rattailed maggots or dung flies that infest polluted water.

Intriguing Story

One intriguing story about rattailed maggots tells how they once saved an apple crop in the State's fruit belt. The story is sometimes extended to show how a muskrat saved an apple crop.

It seems that a farmer who bought a hive of bees to fertilize his apple blossoms also sprayed his trees and killed the bees. The orchard had been heavily fertilized with manure, much of which washed into a neighboring waterway. A muskrat piled some trash against a fence and dammed up the polluted water forming an ideal spot for a crop of rattailed maggots to develop. The adults of these dung flies emerged just as the apple blossoms bloomed. They pollinated the flowers in place of the missing bees and saved the crop for the farmer. The rattailed maggots developed in the stream bottom and in a way saved the crop of apples which otherwise might have been a loss rather than a profit. Incidentally, a farm boy drank some of the polluted water and took into his system some of the maggots. Much to his discomfort they developed normally in the boy but eventually they passed out of his system and he recovered. This shows how involved the interrelationships of animals associated with stream beds may be and the importance of knowing how to manage what happens in a given area.

Worms

Worms of many sorts may abound in the small accumulations of water that remain in the crevices of a stream bed. These may include earthworms whose relation to fish and to soil management is well known. There may also be a variety of molluscs to be found in semidry stream beds. Among these may be the pond snails, particularly the disc pond snails, that should be appreciated. Fortunately, our American species are not known to act as hosts for some species that live in the Old World.

The nearest relatives of the European snails that are so dangerous are the snails found in water which form a coil not a spiral. Many of our related snails may be attacked by minute worms that swim to them and attack the exposed fleshy part of the animal exposed at the opening of the shell. The worms may kill the animal in the shell and the animal may decay causing the shell to float to the surface where it may drift ashore and be found. Other parasites may attack the pond snails of our waters killing them but these are not so dangerous as Old World species. The probably most dangerous of the Old World forms abound in the sluggish rivers of Africa such as the Nile. Some of the snails found here will attack the bare legs of human beings wading in the mud and bite them. From this bite may be transferred a parasite that develops in a human being causing a disease known as schistomiasis. In this disease a healthy human may become so badly affected that he cannot work and may die. The disease may become so general that whole populations may become affected with great loss of ability to do work and of course loss of ability to make a living. Whole populations have been affected and become unproductive. Most humans so affected tend to die early in life and not produce what might otherwise be the case. It is believed that in the past whole populations have been unable to survive and have been obliterated.

There are at least two types of this trouble. One is known to attack the kidneys of the host human being and to pass out in the urine where it can reach a new host. The other may pass into the water through human manure and spread the disease in that way. Huge government grants have been made to try to get people to assist in preventing the spread of this disease, but human nature, being what it is, it will probably call for a discipline which cannot be expected of those who live where the trouble is dangerous.

It is believed by some that the construction of the huge dams that are being built in the Nile may help to spread rather than restrict the disease. If this proves to be the case the country that has been financing the dams may eventually be responsible for the trouble. Here is a situation of major importance over major portions of the world where the snails that live in the river or stream bottoms may be able to defeat any good that others may wish to cause. This may prove to be even more important than war and certainly may be more destructive of human life. It may well be the most important things that can be associated with stream bottoms. Fortunately, it is not found in America but it could be used against us at some time.

Things Under Stream Bottom

Under the bottom of stream bottoms serious and often important situations may exist. For seven years I taught in a college at Cedar Falls, Iowa. Here, the Cedar River is joined by a small and highly variable tributary, Dry Run. At flood time, this stream may be a torrent to over 100 feet wide to over 8 feet deep carrying mud, trash and destruction with

it. In the upper mile or so it flows indiscriminately over corn fields, grassland and highways. In its downstream course, it crosses deep deposits of rich black soil, bare exposures of strata of lithographic limestone, some wasteland, stream-washed deposits of quartz rocks, sandstones and a general miscellany of glacially deposited gravels, sands and other earthy materials of the average Iowa prairie land. It is an almost ideal situation in which to teach the story of a stream bottom. I have frequently wondered why I ever left such an interesting natural laboratory to teach in the East. Together with a few undesirable features it had almost anything a naturalist could desire.

Dry Run apparently stopped abruptly in a little limestone quarry at some times in the year. Apparently it just ran into a huge pool and there vanished underground. What happened to it underground was an enigma for some time. However, the water supply of Cedar Falls once was recognized as the source of an epidemic. It was discovered that the vanished stream ran underground for some miles only to emerge as polluted as ever from what looked like clear and inviting springs. The earthy materials over which the waters of a stream bottom flow may well indicate the chemical nature of the subterranean stream bed. Among the rather conspicuous types of minerals in solution in subterranean stream bottoms are those rich in lime, in solutions resulting from passage over granitic rocks (soft water), sometimes with high sulphur content possibly associated with volcanic deposits, and not infrequently where the water has access to salt deposits and may feed into salt springs. Whatever the major chemical that enters into solution from underground streams may affect the life of the resultant stream vitally and should be of primary interest to men planning to use that water. Laymen may recognize these solutions as salt water, sulfur water, hard water, soft water and so on. These terms are highly generic but the economic variation may be sometimes ridiculously specific. Advertisers of the merits or reputed merits of minerals in solution in natural waters in streams sometimes give free rein to their imaginations. Confusion has sometimes arisen over undisciplined use of the word sand as a filter. "Sand" usually refers to the size of particles of earthy materials not to their chemical nature. The use of sand produced by fracturing limestone cannot be expected to yield similar nutritive values in agriculture to sands produced by fracturing granitic rocks and each is technically truly sand. Failure to recognize truth in advertising here may have serious consequences economically, physiologically, physically and otherwise.

Crustacea

Just ordinary stream beds offer such a variety of living things and of places in which organisms may live that it would seem we should all commit ourselves to understanding a few representative organisms found there. Some of these organisms must be understood to protect ourselves and our civilization but there are many common critters there that can teach the elementary things we must understand to be intelligent in what we do with a stream bed. Possibly the crustacea present us with the greatest opportunity to understand the story. It is doubtful if there is any natural streambed that does not support a population of representative crustacea. These undoubtedly include crayfish, fresh-water shrimps, water sow bugs. The plants that grow on the rocks of a stream bed are of course the most fundamentally necessary since they supply the basic food and cover necessary for survival of many of the animals. They are, however, too small, too inert often to hold our interest. You can pick up almost any of these plants without getting the response that comes when you try to pick up a crayfish but no one can say which of the two is the more important. What one may learn in a biology laboratory about a crayfish is probably necrology though biology can be more interesting. Any teacher can buy pickled crayfish but few teachers take the time to collect some living crayfish from a stream bed in spring, bring the animals from cold spring waters to warm laboratory waters in season and see what happens "natcherally." Fewer still have the patience to feed live crayfish until it is necessary for them to shed their shells and adjust themselves to a new life where they can remain upright unassisted in a clean aquarium. Even fewer students have tested a freshly-cooked crawfish that for safety's sake has been reared in clean water and still does not have polluted food in the body. Hundreds of tons of crayfish worth thousands of dollars are harvested in Wisconsin, Oregon and Louisiana annually for one purpose or another. The live animals are scavengers in the first place and spend their lives cleaning up stream beds. They may live in crop fields, swamp lands, under water. They may burrow to 4 feet underground. They may live under rock bottoms, sandy bottoms, in plant-covered bottoms. They may build chimneys from dens in burrows. They may require two years to complete a life history or may shorten this cycle considerably. They may live to seven years or more as adults. In a typical life cycle, a female may lay up to 200 eggs in March which she carries under her abdomen until by mid-June, when they desert her and become independent. Should they lose a leg, they may grow a new one. They crawl forward and swim swiftly backward as occasion demands. They have a good market value to bait fishermen and are able to maintain substantial populations with little care and expense but they yield satisfactorily to intelligent management.

Other crustaceans that depend on stream beds for survival may well include water sow bugs which can live in water with relatively low oxygen content and fresh-water shrimp which abound in water which is well oxygenated. These are used in fish hatcheries as fish food but their presence in great numbers in water cress may explain why so many trout are caught when baits are allowed to drift near cress beds. There are few more valuable fish foods than fresh-water shrimp which may lurk in plants like cresses. Fresh-water shrimps are commonly found in mated pairs with the male the smaller animal. Maturity may be reached in about a month but breeding does not ordinarily take place at temperatures below 64°F. Crustaceans like fresh-water shrimps and crayfish which can turn plants into valuable fish food may well be one of the most valuable of food chains associated with stream beds.

Aesthetic Value

One cannot dismiss considering a stream bed as a place up which outdoor folk love to wander. Little gorges are a public asset which planners of development of areas should not overlook. The chain saw of modern times in the hands of almost any vigorous young man should be outlawed in any country of little gorges and stream bottoms. It is too easy for such a combination to wreck a place of beauty which may have taken a human generation to create.