

tion in the height of water in some wells coincident with that in a neighboring body of water in which there is perceptible tide was long ago recognized by members of the Louisiana State Geological Survey and others, and has also been observed in wells located near the seacoast in many other regions. But that there is no underground current from the Gulf landward is evident from two facts pointed out by Prof. Harris: (1) When pumping in the affected wells ceases for a few hours the water level quickly rises

above the tide, and (2) any water derived from the Gulf would possess a saltness that has not thus far been recorded in any deep well in this region.

The controlling factors in the underground water conditions are apparently the surface features, which have a marked influence on the rate of underground as well as overground flow, the character of the rock formations that hold the water, and the heavy rainfall. The annual precipitation in the southern part of the State is about 55 inches. This means that each

acre of land receives each year more than double enough rain water to irrigate it properly if planted in rice. Of course much of this water is lost, so far as agricultural purposes are concerned, by flowing away in surface streams; but that much of it also is absorbed by the soil and is transported to distant places through underground porous layers is evident from the existence of many satisfactory deep and artesian wells throughout the southernmost parishes of the State.

# FISHES AND THE MOSQUITO PROBLEM.

## THEIR SERVICEABILITY AS MOSQUITO EXTERMINATORS.

BY WILLIAM P. SEAL.

It may be safely stated that all small fishes, whether of small species or the young of the larger kinds, will be found to devour mosquito larvæ with avidity, but notwithstanding this fact, observations made in aquaria are of little value as indicating the usefulness of a species under natural conditions. The natural habits of the species are the only safe guides. Some species range in the quiet open water, while others are always to be found in the currents; some live among aquatic or semi-aquatic plants; some are solitary; some gregarious; some are wholly carnivorous, others herbivorous, or largely so, and others again are omnivorous. Some are sluggish or lethargic in habit, others apparently always in motion. Then again there are those that feed on the bottom, others that seek for food in the currents, and some that seem only to wander about stealthily without fixed habits, but taking whatever comes in their way. There is another class which are surface feeders—the top minnows. These are continually skimming the surface of the water, forcing themselves through, over, and among aquatic plants that lie in feathery masses at the top, though they do not fully exhibit this habit within the restricted limits of the aquarium.

Thus it will be seen that we have a great diversity of characteristics to consider in estimating the value of a species for our purposes.

The young of many of the smaller food fishes, such as the pike and the common sunfish—generally known as “pumpkin seed”—are very destructive to the smaller species most useful as mosquito destroyers, but in general they are not to be found where mosquitoes breed. There are in fact only a comparatively few species of fishes that can be considered directly useful in relation to the mosquito problem. This, of course, does not militate against the fact that if it were not for the innumerable hosts of fishes and insects inhabiting our larger waters, thus preventing the more general breeding of the mosquito, human life would be rendered unendurable. In that larger sense all of them have a value.

In a large number of observations it was found that if say a dozen tubs were arranged side by side, and eleven of them were stocked with fish, the eggs of the mosquito would appear only in the uninhabited twelfth. It might appear at first thought that the fishes had probably eaten the mosquitoes that had attempted to deposit their eggs in the inhabited tubs. But it is only reasonable to suppose that in the long ages they have acquired that instinctive power of discrimination—so general in the animal kingdom—which would lead them to deposit their eggs where there would be the least danger of their destruction. It would require no greater exercise of inherited instinct than that which incites the cunning and celerity which enables them to avoid a quick slap of the hand. Other observations also lead to the belief that mosquitoes, except *Anopheles*, systematically avoid depositing their eggs in waters which are already inhabited by fishes and aquatic insects, unless there are in such places masses of grass or other plants, bushes, or brush, all of which afford some measure of protection.

The stocking of natural waters with fish for mosquito destruction would, of course, be subject to the limitations imposed by nature, as in fish culture. Only practical observation and experiment will determine to what degree it can be made successful, or how far it may be needful. Fishes exercise choice in the selection of their habitats, and will if possible migrate from such as do not fully meet their requirements, or which contain too great a menace to their safety. Their enemies are everywhere abundant. Yet the limited geographical range of a species is not proof positive that there are barriers to its extension. In the egg and fry stages the destruction of fishes is very great from the voracity of their own kind. Then they are favorite food for water insects and their larvæ, and even of forms of life as low as the hydra. The later

destruction by frogs, snakes, turtles, birds, etc., is also very large. The great fecundity of fishes is indicative of their great mortality.

It becomes a question, therefore, to what extent nature can be aided or reinforced in this respect in natural waters. To doubt that there are possibilities in the introduction or transfer of small species of fishes to other waters for specific purposes would be to discredit the fundamental principles of fish culture.

It seems to the writer that the providing of fishes for stocking waters infested by mosquitoes with fishes suitable for their destruction, or of experiment in this connection, is as properly the function of fish commissions as that, at least, of stocking waters for purposes of sport and recreation, for trout culture has no economic value at all commensurate with the outlay involved, and benefits only a very few. There is no good reason why legislation should not be invoked in this direction, as the benefits resulting will be shared by all alike, without regard to race, color, or condition of pocketbook.

There is one class of waters to which little attention has as yet been given, which might be not inaptly termed the incubators and brooders of *Anopheles*. These are the ornamental plant ponds, which have become wonderfully beautiful and attractive landscape features of our public parks and great private estates. It is in these places that *Anopheles* find to perfection the conditions that foster and protect them, no doubt looking upon them as having been specially developed for their comfort and happiness. For *Anopheles* larva may be found in abundance wherever there are plants to shelter them. And not only do they lie concealed above or among the plants, but they assimilate so closely to their surroundings in color that only the experienced can discern them. They may be found in the grasses or sedges that margin a rapid-running brook, among the cat-tails and flags, the water poppies and water hyacinths, over the masses of feathery plants reaching to the surface in the ornamental pond or lake, and even in the concavity of the floating dead leaf, or among the drift of seeds and dead twigs where the water of streams is sluggish. Thus the one species of mosquito in our northern waters having a malignant character is the best protected, and has attracted the least attention in the work of extermination. This genus does not appear in sudden irruptions of “clouds,” as does the *Culex* shortly following a heavy rainfall. But its breeding is going on continuously and insidiously, so securely hidden and protected that comparatively few are destroyed in the larval stages. And so much more stealthy and undemonstrative are the attacks of the adult, that they more easily escape destruction also.

As a destroyer of *Anopheles* the writer has for several years advocated the use of *Gambusia affinis*, a small viviparous species of fish to be found on the South Atlantic coast from Delaware to Florida. A still smaller species of another genus, *Heterandria formosa*, is generally to be found with *Gambusia* and is of the same general character. The females are about one inch long, and the males three-quarters of an inch. Both of these species are known as top-minnows, from their habit of being constantly at the surface, and feeding there. The conformation of mouth, the lower jaw projecting, is evidence of their top-feeding habits. Both of these species are to be found in great numbers in the South in the shallow margins of lakes, ponds, and streams in the tidewater regions wherever there is marginal grass or aquatic and semi-aquatic vegetation. They are also to be found in shallow ditches and surface drains where the water is not foul, even where it is but the fraction of an inch deep. In fact, if any fishes will find their way to the remotest possible breeding places of the mosquito, it will be these. And they are the only ones, so far as the writer's observation goes, that can be considered useful as destroyers of *Anopheles* larvæ.

*Gambusia* is found in the Ohio Valley as far north as southern Illinois, where the winter climate must be at least as severe as that of the coast of New York and New Jersey.

Dr. Hugh M. Smith, Deputy U. S. Fish Commissioner, informed the writer that he had examined the stomachs of several hundreds of *Gambusia* in the Chesapeake Bay and Albemarle Sound waters, and had found the contents to be principally mosquito larvæ.

In the year 1901 the writer suggested to Dr. Smith the desirability of experiment with *Gambusia* in this connection by the U. S. Fish Commission, but was informed that such an experiment would be foreign to the functions of the Commission; that it would more properly belong to the Entomological Division of the Agricultural Department. Recently, however, it has been stated in the newspapers that the Commission has sent a messenger from Texas to Hawaii with several thousand *Gambusia* and an allied species, for the purpose of stocking the irrigating canals and ditches with them as mosquito destroyers, thus, apparently at least, showing a practical appreciation of the suggestion. Dr. Smith has since confirmed the report in a letter to the writer.

The experiment in question has been carried on in a small way for three years or more by Prof. John B. Smith, and the further experiment of acclimating *Gambusia* and *Heterandria* has been made during the past winter with apparently favorable results.

While, as has been stated, all fishes have some measure of usefulness, if only in the way of deterrent effect, there are only a few species likely to be found in waters in which mosquitoes breed. The most important of these are the gold fish (introduced), several species of *Fundulus* (the killifishes), and allied genera, three or four species of sunfish, and the roach or shiner and perhaps one or two other small cyprinoids. In addition there are a few sluggish and solitary species like the mud-minnow (*Umbra*) and the pirate perch (*Aphredoderus*). The sticklebacks have been mentioned in this connection, but the Atlantic coast species, and probably the entire family, are undoubtedly useless for the purpose, being bottom feeders, living in the shallow tide pools and gutters, hidden among plants, or under logs and sticks at the bottom, where they find an abundance of other food.

In the salt marshes there are myriads of killifishes running in and out and over them with each tide, while countless numbers of other and smaller genera such as *Cyprinodon* and *Lucania* remain here at all stages of the tide. So numerous and active are all of these, that there is no possibility of the development of a mosquito where they have access.

Of the killifishes two species, *Heteroditus* and *Diaphanous*, ascend to the furthest reaches of tide flow, but it is a question as to whether they would prove desirable for the purpose of stocking land-locked waters, since they are a good deal like the English sparrow, aggressive toward the more peaceable and desirable kinds. Even *Cyprinodon*, which would at first thought be a valuable small species in this respect, is viciously aggressive toward goldfish and no doubt all other cyprinoids. It is so characteristic of all the cyprinodonts, that they can only be kept by themselves in aquaria. They are the wolves or jackals of the smaller species.

The writer has come to the conclusion, after many experiments in both tanks and ponds, that a combination of the goldfish, roach, and top-minnow would probably prove to be more generally effective in preventing mosquito breeding than any other. The goldfish is somewhat lethargic in habit, and is also omnivorous, but there is no doubt that it will devour any mosquito larvæ that may come in its way, or that may attract its attention. The one great objection is that they grow too large, and the larger will eat the smaller of them. That is one of the drawbacks to goldfish breeding. There is no danger of overpopula-

tion, but there is of the reverse. Whether or not it is the same with the roach, they are never excessively numerous, although no doubt the most abundant and most widely distributed of the Cyprinidae. They are largely the prey of predaceous fishes, and never approach to the numbers of the killifishes. But at all events they are not lethargic like the goldfish, being on the contrary one of the most active of the family, and equally at home in flowing or stagnant water. The roach is always in motion, back and forth, and around and about, on a never-ending patrol.

The top-minnow would supply the deficiencies of the other two species, and in combination they should very thoroughly populate any waters not already stocked with predaceous kinds, and exercise an effective control. One of the great difficulties in the case is that there are dozens of kinds of insect larvæ besides those of the mosquito, and other forms of life as well, which are natural and possibly preferred food of the fishes, thus requiring an enormous population to devour them all.

The larvæ of gnats, midges, ephemera, and other flies and insects which breed in the water, as well as the many small crustaceans, afford a menu of delicacies that would stagger a gourmand. The above combination of mosquito destroyers might be supplemented by two small species of sunfish, *Enneacanthus obesus* and *E. gloriosus*, which live among plants and would be a check on larvæ other than the mosquito. The black-banded sunfish, *Mesogonistius chaetodon*, would also be desirable for this purpose, if they were not so difficult to obtain in large numbers. One or both species of *Enneacanthus* can be found wherever there are aquatic plants. The above-mentioned five species in combination seem to be the most suitable for pond protection of all those which are known to thrive in still water, and which in any degree possess the desired qualities. As has been stated, the killifishes would probably be found to be undesirable. In their natural habitat, the tidal streams and great expanses of small marsh, their efficiency is unquestioned.

There are many places at the seashore where there are swales or hollows filled with grasses and bushes, which in periods of rainfall become breeding places for the mosquito, especially of *Anopheles*. If these places are stocked with fish, the result is that when they dry up the fish perish, and the operation must be repeated after each filling.

The writer has suggested digging holes about four feet square down through the turf into the sand stratum in the deepest part. Two feet is usually sufficient to secure a constant water supply where the fish can exist until the hollow is again rain-filled. *Cyprinodon* and *Lucania* would be desirable for such places, and they are to be found everywhere in the ditches and tide pools on the flats.

To add variety to the treatment of the subject, it might not be amiss to suggest that there is a fish, *Anabrops*, inhabiting the fresh waters of South America, which seems to be specially adapted to this purpose. To quote: "These small fishes swim at the surface of the water, feeding on insects, the eye being divided by a horizontal partition into a lower portion for water use, and a portion for seeing in the air."

### USE OF SUBMARINE SIGNAL BELLS IN FOG.

THE Zealand Line, whose vessels run between Flessingue, Holland, and Queensborough, England, seems to be the first to employ submarine bells for signaling, especially during fogs. The two jetties of Flessingue have been provided with fog signals for some time past, but nevertheless the vessels of the line sometimes had great difficulty in finding the entry of the port during fogs. The new system of signal bells is claimed to overcome this disadvantage and to work in an excellent manner. The apparatus consists of a bell at the shore end in which is placed a spring in such way that when the spring is set free it gives a strong action upon a striker for ringing the bell. Thus the sound is clear and penetrating and it is perceived at great distances. The bell is mounted so that the circle in which the sound waves are propagated lies between the two jetties and in this position the effect is strong, while outside of it there is but little sound heard. The vessel can thus find the entry of the port. For this purpose the apparatus mounted on board consists of receiving devices, telephones, and battery. The receivers are fixed near the forward end of the ship and on each side of it and are placed in watertight iron boxes, below the water line. Cables connect them with the battery and with the captain's bridge, where there are two telephones placed. A communicating switch allows of using one or the other of the receivers on either side of the vessel. The sound of the shore-bell is heard very clearly and by means of the commutator the observer can throw on one or the other receiver so as to determine by the relative intensity of the sound whether he is at the middle part or not, and can steer the vessel accordingly. This sound-signaling apparatus has been described in the SCIENTIFIC AMERICAN.

### ENGINEERING NOTES.

Consul-General Robert J. Wynne, of London, reports that according to Lloyd's Register the vessels under construction in the United Kingdom at the end of March, 1908, were 847,501 gross tons, against 1,306,087 at the end of March, 1907, a decrease in a year of 35 per cent, of which 100,000 gross tons occurred during the last three months of the year. The present depression extends to every shipbuilding center in the kingdom with the exception of Barrow.

Alfred Christensen has submitted to the Danish government a scheme for a canal across the northern part of the peninsula of Jutland, making large use of the Liim Fiord, which passes into the peninsula from the Kattegat for a considerable distance inland. The canal, as planned by Mr. Christensen, who applied for a concession to undertake the work, would have a depth of 26.25 feet and would probably secure a large part of the traffic between the North Sea and the Baltic. Dues would be imposed on all large vessels using the canal, and, while the concessionaires would provide the funds for executing the works, they would be willing to arrange for the state to acquire a share in the undertaking.

Consul Joseph I. Brittain reports from Prague that a recent issue of an Austrian journal gives an account of an automatic money assorter, which is thus described: The inventor claims that it will assort metal coins which have been thrown together regardless of their denominations, placing each denomination in a separate basket. The various coins are thrown indiscriminately into a funnel at the top of the machine, and from the funnel they slide downward, alighting on a spiral track. This track has a protecting edge or raised border containing slits corresponding to the various sizes of the coins. As the coins of various denominations glide downward onto the track, through some peculiar mechanism of the machine they pass through the slits corresponding to their various uses, entering their respective baskets at the bottom of the machine.

According to the Engineering Record, an interesting salvage operation was carried on in the River Mersey, England, in raising the coaling barge "Pensarn," which is fitted above its flat deck with a steel tower 96 feet 6 inches high, from which cantilever arms project so as to reach over the hatchways of vessels. The usual practice of calking the defective seams, sealing the hatchways, and then pumping out was not followed, because, as stated in The Engineer, London, the weight of 16 feet of water above the flat deck was too great for it to support. The Liverpool Salvage Association, which did the work, built a cofferdam 50 feet long and 20 feet deep on the deck, surrounding the hatchways and the steel tower, and after calking the seams, both the cofferdam and the hold were pumped out at the same time. The cofferdam was built in 6 x 20 foot sections, the lower ends of which were bolted to a log base which the divers had previously secured to the deck. The sections were built on shore and floated to place.

At a meeting of the Society of Engineers, Mr. Robert H. Smith, em. professor of engineering, read a paper on "A New Design of Gear Teeth, to Minimize Waste of Power and Wear." The author enumerated ten kinds of excellence in the teeth of wheels, only two of which influenced the orthodox cycloidal and involute designs. Besides uniformity of velocity ratio and strength, the other points of consequence were obliquity of action, number of contacts, smallest practicable number of teeth, undercutting, sharpness of outline at shoulders, frictional waste of power, abrasive waste of material, change from correct shape by wear. He explained the advantages of short teeth, and denied that the thrust could be effectively divided between two contacts. It was, however, essential that contact should begin before the previous contact finished. In the author's new design the contact lasted 1.12 times the pitch with two 12-teeth pinions gearing with each other, and 1.13 times the pitch when two very large wheels are in gear, the addendum of the tooth being made one-fourth of the peripheral pitch. The author then gave a simple formula for the frictional waste work of toothed gear, and calculated that of his new design in an average case to be in the ratio of 106 to 180 to that of ordinary involute teeth. The leading aim of the new design was to combine small obliquity of thrust with avoidance of sharp curvature in the outline. The touching face of the one tooth should have a radius of curvature only little less than that of the flank of the tooth geared with it; in other words, the "closeness of fit" between the two should be as great as possible. This prevented the squeezing of the unguent out from between the bearing parts, increased the effective width of bearing surface, and diminished the actual intensity of pressure. The sharpness of outline at the shoulder increased with decrease of obliquity of action, and the actual design was a compromise between these opposing influences such as yielded maximum efficiency, and also secured a substantial increase of strength.

### TRADE NOTES AND FORMULÆ.

**Ferric Phenolene.**—This is a disinfecting powder for stables, sewers, privies, cesspools, drains, etc. Mix thoroughly 30 parts by weight of animal oil (oleum animale fœtidum) and 70 parts of ferric sulphate. A pulverulent mass will be obtained. The mixing of the two constituents is performed mechanically by vigorous stirring in a stirrer.

**To Produce Artificially Matured Cigars.**—Boxes of cigars are laid on a grating or gridiron over a trough or vessel containing calcium chloride in powder or ferrous chloride or other substance possessing a strong attraction for water. A few sheets of blotting paper are placed at the bottom of the trough to absorb the moisture, and the boxes are closed. The damp air in the boxes draws the moisture out of the cigars, which are quickly matured by this process.—Der Industriöse Geschäftsmann.

**Paper for Keeping Articles Moist.**—To render paper, parchment, and other fibrous substances soft, pliable, and elastic, capable of absorbing and retaining moisture, also to render them transparent in many cases, these should be treated with a solution of potassium or sodium acetate, grape sugar, dextrine, starch, and other mucilaginous and gelatinous substances may be added according to the purpose for which the paper is intended to be used. The addition of an antiseptic, such as carbolic acid or salicylic acid, is also recommended.—Neueste Erfindungen und Erfahrungen.

**To Clean Old Oil Paintings.**—Mix 125 parts by weight of ox gall, the same quantity of vinegar, 250 parts ammonia, and 32 of salt, and allow the mixture to stand for 24 hours in a closed and tied-up pot till the salt is dissolved; then stir and brush the pictures well with a soft brush dipped in the solution. Then place the pictures in a slanting position, rinse them off at once with cold water, and when dry apply varnish. Old oil paintings may also be cleaned by rubbing them carefully with a small sponge dipped in a solution of soap. They should then be rinsed several times with cold water, dried in the open air and provided with a fresh coat of varnish.

**To Loosen Glass Stoppers.**—When glass stoppers cannot be removed from bottles or glasses, pour a few drops of sweet oil around them and then, with a key, engaging the stopper with the bow, endeavor to turn it around. If this is unsuccessful, stand the bottle near the stove, not on a very hot part of the stove, so that it may be gradually heated. After a while, try, by tapping lightly on the stopper, whether it cannot be loosened. Should this not be the case, the process, as above described, will have to be repeated three or four times, after which the stopper will be loosened without fail. In cases of other fast stoppers, where the contents of the bottle are of slight importance, drop a few drops of petroleum on them and let them stand a few moments.

**To Smoke Eels or Salmon.**—To smoke eels or salmon, salt them with ordinary salt and a little niter and keep them for four days in the brine. Then take a large cask, as high as possible, remove the bottom, bore a number of holes at the top and through the staves, and rest it upon stones rather more than a foot high, so that there is an empty space beneath. Now suspend the eels or salmon, previously fastened to thin sticks, in the cask and light under them a choked fire of birch or oak leaves, juniper twigs, and juniper berries and allow them to remain therein for three days. It is important that the fire should not be allowed to burst into flame and that an abundant quantity of smoke should be produced. To be considered good, smoked eels and salmon should have a nice golden yellow color on the outside and a fresh red color like raw ham, on the inside. They should also have a pleasant smell.—Der Industriöse Geschäftsmann.

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