CHAPTER VI.

Food and Feeding

FOOD AND FEEDING OF GOLDFISHES AND OTHER FRESHWATER FISHES

One of the fundamental principles of dietetics is that the chemical composition of food should conform with the chemical composition of the body and that those which furnish this in the best proportion are not only the most nutritious but also best maintain the animal organism in its most perfect condition. For this reason the diet of coldblooded animals should consist most largely of vegetal substances and of coldblooded animals, their natural food, as having no body temperature to maintain they do not require as large a proportion of the rich hydrates of carbon and other heat-producing foods necessary to warmblooded animals. Experiments with food fishes have demonstrated that with this natural food the fry will grow seven times more rapidly than on a diet of mammal flesh.

Dietaries for mature goldfishes may be divided into several classes: Barely subsistence diets, leading to semi-starvation, stunting and deformities; healthy diets, producing normal growth, vigorous health and fine development; fattening diets, leading to coarseness of appearance, insufficient fin development, indolence and predisposition to disease; overfattening diets, producing disturbances of the digestive system and a suppression of the reproductive organs; and overfeeding, which leads to water contamination diseases, asphyxiation and death.

Barely sustaining diets usually occur from the dread of overfeeding or from overstocking, and reduce the fishes to a point below healthy development. When the fishes are starved in infancy they become permanently stunted, the bones hardening so that no subsequent care or feeding will cause them to expand sufficiently to permit of normal growth; for which reason the early feeding stages are the most important in the rearing of fine fishes and require intelligent understanding of their wants and requirements. Healthy diets imply not only a sufficient quantity of food, but those composed of the proper constituents to stimulate active assimulation, to supply all the needs of the animal organism in proper proportion and to produce a vigorous growth, fine development of both body and fins, a clean and elegant appearance, and robust health. Fattening diets are such as cause overstimulation and excessive nutrition by their too considerable richness of composition and produce fishes lacking in vitality, and the elegance of appearance and fine fin development, noticeable in those more carefully reared. This is sometimes attributed to pond culture, but is as often due to

highly nutritious food excessively fed, so that the labor of procuring a livelihood is reduced to a minimum and by constant gorging the fishes become coarse and misshapen. Excess of food also produces disorders of the digestive system and the consequent liver affections. Overfattening diets will produce in the goldfish the same results as in other animals and an overaccumulation of flesh or fat will invariably be followed by a partial or total sterility, just as the removal of the genital organs will produce a rapid accumulation of flesh. Overfeeding is a most serious evil as very many of the diseases may be directly or remotely traced to this cause and its attendant results. Sufficient food should be given, as much as will be at once eaten, and to fully satisfy the hunger, all additional feeding is a source of danger to the fishes.

It was formerly supposed that the carp subsisted on vegetal food only, but it is now known that its principal diet consists of snails, crustaceans infusoria and other small aquatic fauna, it also deriving albumen and soluble hydrates of carbon from the minute aquatic flora and the young shoots and roots of plants; and this applies to all the Cyprinidæ,including the goldfish.

In the aquarium, fully developed goldfishes should not be fed oftener than once a day in warm weather and on alternate days or intermittently when the weather is cold or the temperature of the water low, receiving less than one per cent. of their judged average weight of nutritious food, regulated that it will be immediately consumed, not carried off and later disgourged to contaminate the water. All fishes can live a long time without food and experience enables the culturist to judge from general appearances when they are sufficiently fed. Whenever they are crowded in a small space feeding should be done with additional care or the equilibrium may be disturbed, even with a very considerable plant growth. Inferior, stale or sour food should never be fed, and the feeding and care of the fishes should be vested in one reliable person.

Feeding the Fry. The foregoing more particularly applies to growing and mature goldfishes; the important considerations of feeding the alevin and fry require special mention, as this greatly influences the development of the finely bred forms. When too sparingly fed or at long intervals, the exertion of procuring food necessitates an activity detrimental to the development of the desired short bodies and large fins, while sufficient nutrition tends to slothfulness, an easy existence and the consequent fuller development of these desired characteristics. A short rotund body also requires a shortening and crowding of the alimentary organs together with a partial displacement of others; the double tail and long fins further hampering the movements of the fish, so that any active strug-

gle for food can only tend to the elimination of the finest fry and the survival of the better adapted but undesired long-bodied, single-tailed fishes.

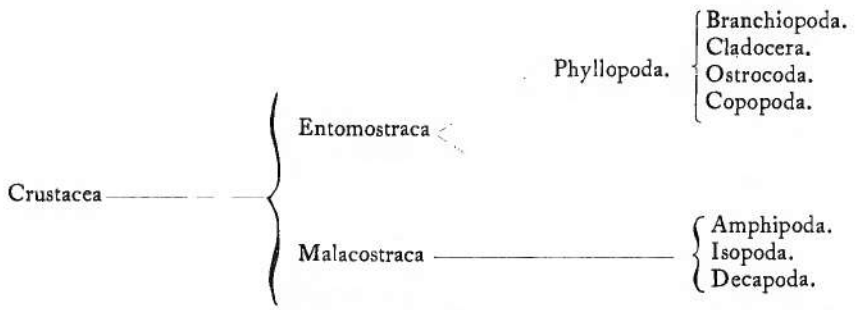
To achieve most certain results, a careful observation of the following suggestions is advisable :—Experience has proven that it is best to take the spawn and the plants to which it adheres from the spawning bed or tank and place them into filtered water to hatch, thus largely avoiding the danger of the presence of fungus spores and enemies; but it is well to introduce a few pots of clean growing plants to supply the necessary oxygen and prevent the asphyxiation of the hatching fry. Immediately after hatching, the alevin is still attached to the umbilical sac and requires no other food than is furnished by it and that present on the plants and in the water; but after its absorption young fishes may be fed on rice flour scattered on the surface of the water, or a little of the broth of oat meal, but the best food is the natural pond-life food, and this should be continued until it is ¾ to 1 inch long, when prepared foods may be fed, if natural food is no longer to be obtained.

Together with the plants a small dish containing clean soil should be introduced,as it contains substances necessary for nutrition and will stimulate the development and propagation of infusoria, the minute animal life which is the natural first food of the newly hatched alevin. This is manifested by the greenish color of the water, which is also in part due to the presence of tiny vegetal life, the diatoms and other small algæ. After the fry have reached the age of a week, a half pint of water of pronouncedly green color, taken from a tank in which a considerable growth of algæ has collected, should be added every few days, then after a week live food should be fed.

It should be here repeated that a low temperature of the water and insufficient light will seriously affect the survival of the fry, as the generally accepted opinion that fishes do not feed freely when the weather is cloudy and the water cold applies to young goldfishes; but strong sunlight must be avoided, as that also is injurious.

When the stage of feeding live food has been reached, it should be given in liberal quantity about three or four times a day, carefully screened that only the smallest entomostraca are introduced into the rearing tanks; and though it has been observed that when very abundant the larger may prey upon the young fishes, it is always the weaklings which are attacked and these can be dispensed with; the healthy and vigorous young fishes escape these attacks or but few succumb.

NATURAL FOOD. The live food consists of the following Crustacean denizens of still water ditches, ponds and streams, which are classified as follows:



ENTOMOSTRACA. This sub-class of the Crustaceans are simple organisms usually of small, often microscopic size. Order PHYLLOPODA. Body segmented, covered with a carapace, swimming feet with branchial sacs, mandables without feelers, and reduced maxillæ. Sub-order BRANCHIOPODA. Body distinctly segmental, numerous pairs of swimming feet, shieldshaped carapace, heart an elongated dorsal vessel with numerous pairs of ostia.

BRANCHIPUS STAGNALIS. Fig. 64. This freshwater Crustacean, known as the Spring-time shrimp, reaches a length of 1.5 to 2 centimeters. The body is covered with a segmental mantle, the head is large and the abdomen furnished with caudal appendages. It has eleven pairs of legs, furnished with breathing and swimming hairs, two pairs of antennæ, and a lengthened caudal appendage with swimming bristles. The crablike eyes are large and distinct. The almost transparent body is of bluish-green color on the back, the head, sides of the abdomen and the swimming bristles yellow, the antennæ and caudal appendages red, and the eyes black. Its food consists of tiny water animalculæ and algæ, but it will attack spawn and young fishes. It usually swims on its back and is never at rest; the movement is eratic, either by quick strokes of the legs or by springs in the water by means of a rapid movement of the abdomen. A good food for adult goldfishes, and other freshwater fishes.

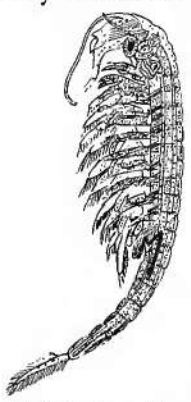


FIG. 64. Branchipus stagnalis. Greatly enlarged.

APUS CANCRIFORMUS. Fig. 65. This freshwater Crustacean may occur in great numbers or entirely disappear for years. In form it resembles the Limulus or King Crab in miniature, as it never exceeds 3 centimeters in length. The body is flat, covered by a shieldlike mantle, and the slender tail is as long as the body. On the shell there are two

paired and one central single eye. It has two pairs of threadlike antennæ. Under the shell there are 60 pairs of gilled legs, of which the first pairs are developed into antennæ-like feelers. It swims on the back and steadily moves through the water by rapid undulating strokes of the legs. The periodic appearance of this Crustacean may be due to the fact that the eggs must be subjected to a period of incubation in the dry earth. The food consists of water animalculæ and decaying vegetation.

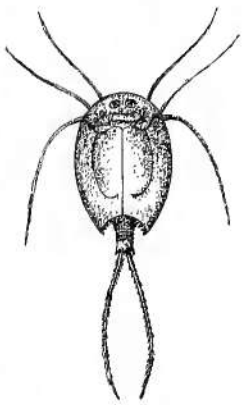


FIG. 65. Apus cancriformus. Greatly enlarged.

It is the larvæ and young of these Branchiopods which constitue the food of the mature goldfish, the adult being of too large size to be readily taken. It is principally the Crustaceans of the following sub-order Cladocera which constitute their live food.

SUB-ORDER CLADOCERA. Compressed body small, indistinctly segmented, enclosed in a bivalve carapace, four or six swimming feet, and the posterior antennæ developed as longer swimming feet. The most general forms are Daphnia, Polyphemus and Leptodora. Daphnella, Sida and Ciriodaphnia also belong to this sub-order.

DAPHNIA. Fig. 66. Four or five species of Daphnia, known to the goldfish breeder by their light green, dark green, red and reddish colors, abound at different seasons in almost every still or stagnant water. Their size is from .75 to 1.5 millimeters. The segmentation of the body is imperfect, the Crustacean being covered by a folded carapace. The head is distinct and the abdomen is turned downward and is in constant movement. The long antennæ are moved at longer or shorter intervals, making the progress a series of rapid starts and stops. Between the abdomen and the carapace of the female is a large brood pouch in which the eggs are stored and hatched and the larvæ only make their escape when they have reached the free-swimming stage. The paired eyes have fused into a single organ. There are five pairs of swimming legs on the thorax. The reproduction of the Daphnia is most curious. During the summer the female develops spores, which, without fructification by the male, develop in the brood pouch to perfect Daphnia in four days, and which, when they have become liberated, in a few days reproduce in the same manner. In the fall of the year the much smaller males appear and the sexual reproduction takes place. Winter eggs are produced, the thick shells of which protect them through the cold season. The food of the Daphnia is de-

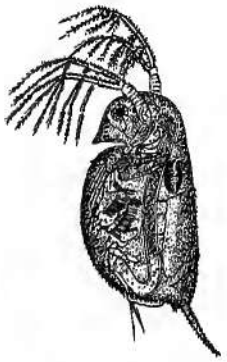


FIG. 66. Daphnia pulex. Greatly enlarged.

caying vegetation, organic offal and small infusoria. They are the best food for the goldfish. It has been noticed that the tiny newly hatched alevin will follow Daphnia to feed upon the young as they are released from the brood pouch of the female. The most generally distributed forms are *Daphnia lævis*, *D. pellucida*, *D. pulex*, *Daphnella branchyura*, *Ceriodaphnia pulchella* and *Sida crystallina*.

POLYPHEMUS. Fig. 67. One species of Polyphemus is quite generally present in still and stagnant water. This is *P. pedeculus*, of which the body is of most grotesque form, owing to the peculiar humplike brood pouch. It is smaller than the Daphnia, about .65 to 1 millimeter in length.

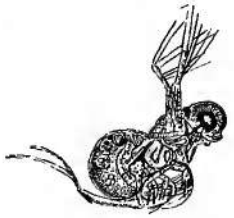


FIG. 67. Polyphemus pedeculus. Greatly enlarged.

LEPTODORA. Fig. 68. One form of Leptodora is quite generally present in larger bodies of freshwater, and may be taken on the surface on bright days. The body is long and is covered by a faintly segmented carapace. There are two long swimming legs and the very long antennæ branch at the ends and are furnished with swimming bristles. *L. hyalina* is the most generally distributed form. Its length is about 1 to 1.5 millimeters.

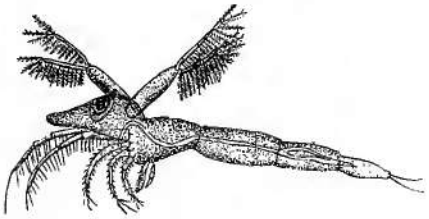


FIG. 68. Leptodora hyalina. Greatly enlarged.

SUB-ORDER OSTRACODA. Compressed body small, indistinctly segmented, in a bivalve shell, five pairs of feet adopted to swimming and creeping. The freshwater form is *Cypris*.

CYPRIS. Fig. 69. Several species are very generally distributed and may be taken from almost every water which contains the other entomostraca. The body is unsegmented and is enclosed in a carapace articulated at the dorsal edge to form a bivalve shell. At the anterior end is a median eye, and there are seven pairs of swimming appendages. Its size is 1 to 1.5 millimeters, and its movements are slow and leisurely either in swimming or in crawling over the bottom. The young are developed in the brood pouch but are expelled in the larvel condition. This Crustacean propagates even more abundantly than the Daphnia, and will prey upon the eggs and embrios of fishes, a number of them may attack an alevin, fastening themselves to its surface and devouring it in spite of efforts to free itself. Goldfishes eagerly eat the Cypris. The generally distributed forms are *Cypris virens*, *C. pubera*, *C. pellucida*, *C. fusca* and *C. ornata*.

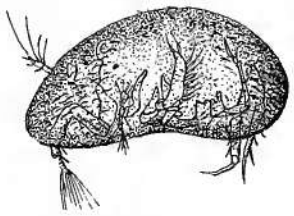


FIG. 69. Cypris virens. Greatly enlarged.

SUB-ORDER COPOPODA. Body small, distinctly segmented, the foremost segment fused with the head; antennæ, mandables and maxillæ well developed, six pairs of swimming feet in the free-swimming freshwater forms, which consist of the Cyclops and Canthocamptus.

CYCLOPS. Fig. 70. Ten or twelve closely allied forms abound in still and stagnant water. Their size is 1 to 1.5 millimeter. The segmentation of the body is perfect, the Crustacean being covered with a carapace of which the first segment is fused with the head. Two long antennæ are present and but a single eye. The swimming legs are attaches to the thorax, and the lengthened abdomen is provided with caudal appendages. Their food is organic substances, infusoria and algæ, and their movements are steady and regular as though propelled by driving wheels. The most generally distributed are *C. thomasi*, *C. gyrinus*, *C. agilis*, *C. edax*, *C. modestas*, *C. ater* and *C. viridis*. *Canthocamptus* is rare in the Eastern and Middle states and occasionally occurs as an unrecognized species.

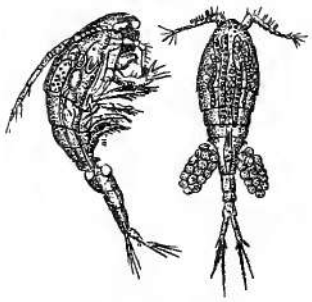


FIG. 70—Cyclops thomasi. Greatly enlarged.

These Copopods possess extraordinary fecundity. In the winter they seek the bottom and hibernate, but when the water reaches a temperature of 45° to 50° F. they revive, their increase being greatest at 65° to 70° F.; when the female every two days develops two egg sacs or external uteri, wherein 16 to 32 eggs are hatched. In two days these become detached, fall to the bottom where the young, almost globular cyclops, having four legs but no tail, undergo a molting in about 15 days, when the other feet and the tail form. In another 15 days they mature and reproduce. Carbonate of lime is necessary in the formation of their shells. They thrive in water infused with vegetal matter in decomposition, but as it does not contract any odor of decomposition it is probable that they live on the infusoria. Potamogeton, Ceratophyllum and Fountain cress, upon which algæ and voucheria will form are usually present to sustain the infusoria. Young goldfishes usually reject Cyclops when they can obtain Daphnia. It has also been observed that some species of Cyclops feed upon fish spawn and will attack very young fishes.

MALOCOSTRACA. These highly organized Crustacea have the thorax of eight and the abdomen of seven segments. The sub-order *Amphipoda* are shrimplike forms with stalked eyes; the *Isopoda* have depressed or flattened bodies and gills borne on the abdomenal appendages; and the *Decapoda* have the thoracic segments united with the head in a carapace,

the three anterior pairs of limbs as foot-claws and the five pairs of posterior limbs as walking legs. The eyes are stalked and the gills thoracic.

SUB-ORDER AMPHIPODA. This sub-order includes the Water-fleas and the marine Sand-hoppers, of which one genus is present in both running and standing fresh water.

GAMMARUS. Fig. 71. This freshwater Crustacean, known as the Water-flea and Fairy Shrimp, *Gammarus pulex*, has a flattened form, the anterior portion consisting of the head and thorax covered with a carapace, and the posterior portion with six segments and a terminal flap ending in a short bristle. The anterior three pairs of legs serve for swimming and the posterior legs for swimming and the hopping motion by which it moves more rapidly through the water. The color is a translucent dusky grey. It is found in muddy streams among half-rotten brush wood and other litter, usually hidden under stones or aquatic plants, generally feeding at dusk or at night, when it either swims leisurely through the water or hops by rapid strokes of the posterior legs. Its food is decaying vegetation, small animals and spawn; and will serve as an effective scavenger in tanks for larger fishes and amphibia but should not be introduced with young fishes.

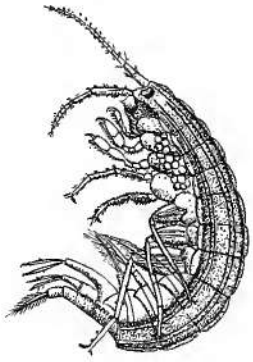


FIG. 71. Gammarus pulex. Greatly enlarged.

SUB-ORDER ISOPODA. This sub-order includes the Water-Asel, Wood Louse and a number of marine forms.

ASELLOPUS. Fig. 72. This freshwater Crustacean is known as the Water-Asel, *Asellopus tenax*, and has a compressed or flattened form and a segmental body covered with an olivate armor marked with lighter spots. It reaches a length of 1 to 1.5 centimeters, and inhabits still and slow-flowing water containing considerable vegetation. Its movements are slow and it is usually secreted in the mud or on the under side of the leaves of aquatic plants; feeding on decaying vegetal substances, smaller animals and spawn, and is an active enemy of very young fishes. Another more slender and longer-limbed form is *Asellus communis*, a New England States species.

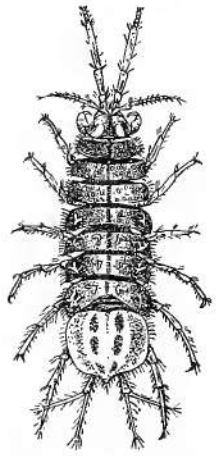


FIG. 72. Asellopus tenax. Greatly enlarged.

SUB-ORDER DECAPODA. This sub-order includes the freshwater Crayfishes, marine Prawns, Shrimps, the true Crabs and Lobsters. These will be treated of elsewhere.

The minute Crustaceans are of the greatest benefit to the growth and survival of the young brood of

goldfishes. Another abundant form of live food is Mosquito larvæ, which should be here mentioned but is more fully described in another Chapter. Too strong light and changes in the temperature of the water seriously affect the survival of this live food. Experienced breeders guard against these by keeping the pails or tanks in secluded places and provide protecting covers. For Goldfishes Daphnia, Cypris, and Mosquito larvæ are the best food, preference being given to the former. For the other freshwater fishes all the mentioned Crustacea serve as food; they may be fed on any of them small enough to be swallowed.

CRAYFISHES. These largest freshwater Crustaceans occur abundantly, in most lakes and streams except in the New England states and the Great Plains region. They resemble the Lobster in miniature. The head and thorax are amalgamated in one mass covered with a carapace. The abdomen is divided into seven segments, six of which bear swimmerets and the seventh a divided flattened tail-fin or telson. The compound eyes are borne on long movable eye-stalks, behind which are two long jointed antennæ and a second pair of short antennules. The mouth is on the under surface and is provided with one pair of mandables, two pairs of maxillæ, and three pairs of maxillipeds or foot-jaws. The segments of the thorax under the carapace bear a pair of prehensile limbs with chelæ or claws, two pairs of ambulatory or walking legs with smaller claws and two pairs of legs ending in simple pointed extremities. These, together with the swimmerets and telson, constitute twenty pairs of appendages. Most localities have several species, difficult of identification, as they all exhibit considerable variation. The distribution of the 79 species of *Cambarus* is limited to the Atlantic water shed and of the 7 species of *Astacus* to the Pacific water shed. The species most abundant from New York to Alabama and south to Virginia are *Cambarus blandinii*, Fig. 73, *C. propinquus* and *C. affinis;* but the greatest number of forms occur in the southern and central portion of the United States. Crayfishes hide under stones or in holes excavated in the banks, where

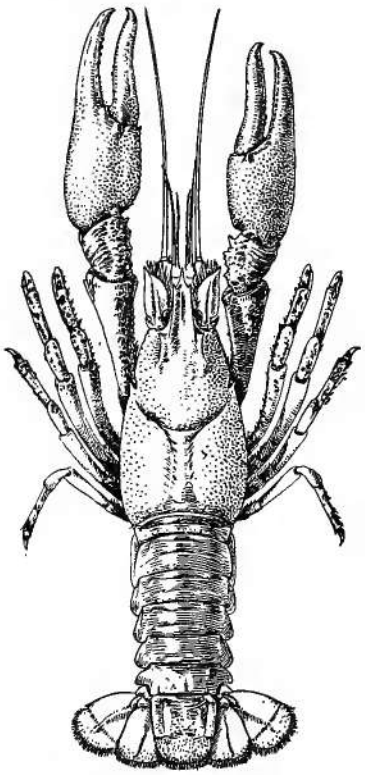


FIG. 73. Freshwater Crayfish, *Cambarus blandinii.*

they sit with the head toward the opening and the claws ready to grasp any smaller creature or dead animal matter. They should not be introduced into the aquarium with fishes but kept by themselves and when acclimatized can be fed on small particles of meat or the flesh of mussels or oysters.

ROTIFERA. The Trochelminths, of which the wheel-animalcules form one group, consist of *Rotifera* and *Gastrotricha*, generally fresh water forms, and *Dinophilea* of salt and blackish waters. About 25 species of Rotifera occur abundantly in the United States in almost all bodies of freshwater. They are of small size inclosed in a cuticle to form a stiff shell. At the anterior end are cilia by which the animal swims and brings food to the mouth, and at the posterior end is a small separate joint, the foot, to which two bristle-like structures are attached. The internal organs comprise an alimentary canal, and nervous, reproductive and excretory systems and mucus glands. They have dorsal antennæ back of the anterior end of the head. Reproduction is by eggs which are developed under the carapace. The genera most generally distributed in the United States are *Branchionus rubens*, *Diurella tigris*, *D. tenuior; D. weberi*, *D. porcellus*, *Rattulus gracilis*, *R. longiseta*, *R. bicristatus*, *R. carinatus* and *R. rattus*. Fig. 74. In the author's vicinity Dr. Joseph Leidy also identified *Acyclus inquietus*, *Apsilus lentiformis*, *Limnias socialis* and a very considerable number of less common forms. Some of the parasitic forms on fishes resemble the free-swimming larvæ of Annelids and Crustaceans.

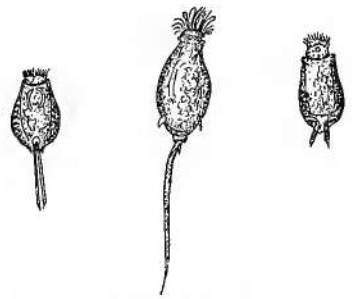


FIG. 74. Rotifera.
1. *Branchionus rubens.*
2. *Rattulus longiseta.*
3. *Diurella tigris.*

GASTROTRICHA. This small group of minute freshwater Trochelminths have spindle-shaped bodies with two longitudinal bands of cilia or swimming hairs on the ventral surface and the mouth surrounded with a circlet of hooked hair-like appendages. *Chætonotus maximus* is the most common form. They are harmless to fishes and spawn.

COLLECTING NATURAL FOOD. For the collection of the minute water fauna a mull net attached to a pole and a covered tin pail are usually employed. During the breeding and rearing season of the goldfish almost any ditch, pool or pond contains them in greater or lesser quantity; but the keeping of a supply is difficult as they may soon die and rapidly decompose, making frequent excursions to the pond necessary. To avoid this, breeders prepare a breeding tank in a shaded locality and a collection of what might be called pure cultures for propagation are made with a pipette or lifting tube, which closed at the upper end may be placed in the water

between the plants and more clean catches made than with the mull net. The tank should be prepared with a layer of garden soil mixed with a little liquid manure covered with pond mud, on this a thin layer of dead leaves, and then filled with water to reproduce pond conditions. Some algæ, voucheria, wolffia and other small aquatic plants will be introduced with the pond mud; and, after stocking, in a short time colonies of shell insects, flea lobsters, water multipedes, infusoria, algæ etc. will develop which should be occasionally replenished by catches in the ponds.

In a small way a candy or battery jar containing a little pond soil and rooted plants, preferably anacharis, will serve; but with ponds or ditches nearby, the mull net will usually be all that is required. Care should be exercised to prevent introducing predaceous insects and their larvæ, parasites or other enemies together with this food.

Preserving Natural Foods. It is the practice of breeders to collect the entomostraca in quantities when they are plentiful and preserve them in a dried state for periods of scarcity. This is done by dipping them from the ponds with the net and filling cans with them in almost drained condition, adding table salt to prevent their rapid decomposition They are then parboiled, strained and evaporated to dryness at low temperature or by spreading in the sun in hot weather. This food contains all the essentials of the pond animalculæ, and will keep almost indefinitely, further eliminating all danger of introducing enemies into the rearing tanks. In its dried state it is used in the best prepared fish foods.

Propagating Natural Food. The artificial propagation of natural food has received considerable attention from the culturists of food fishes. These consist of the minute fresh water fauna together with the larvæ of mosquitoes, gnats, mayflies, dayflies, smaller bugs and beetles. Ditches in the vicinity of the fish propagating basins, for the cultivation of natural food, are prepared with a layer of cow manure in which water plants, including potomogeton, anacharis, cress and confervæ are grown, and partly filled with brushwood, bricks, stones, etc.; in which the animalculæ may secrete themselves; and from which they are let into the ponds with the water supply.

Feeding in the Aquarium. To assure success with the aquarium, it must not only be in natural balance but the food should be either the natural small pond life, or simulate that of nature, and prepared to furnish to the living inmates the proper constituents in correct chemical proportion and easily digestible form. Natural live food should be fed when it can be procured, and which may consist not only of the tiny water entomostraca, but of the larvæ and pupæ of mosquitoes, fly maggots, particles

of worms and other living creatures; but when this cannot be procured or its condition is such that it may be unclean, or that parasites or disease fungi might be introduced with it; then surrogates in the form of prepared foods should be fed. One of the first requirements in feeding artificial food is frequent change of diet and care taken that only such quantities are feed which will be at once consumed, and not a particle left over 15 minutes after feeding.

Substitutes for the natural live food are prepared of the following animal and vegetable substances:—Scalded and dried earthworms; lean raw or dried meat and liver; fish roe and flesh; ant-eggs; raw and boiled eggs; milk curds; dried daphnia; dried prawns (fresh or saltwater shrimp) or lobster; rice wafers, rice flour, pea flour, fine corn meal, dry or boiled oat meal, vermicelli, egg noodles, water crackers, dog biscuit and other hard biscuit. For very young fishes the best substitute foods are rice flour sprinkled on the surface of the water, and oat meal broth. Blood has also been tried but has been found to be objectionable, except for pond feeding.

Raw Meat Food. Any kind of lean meat may be finely scraped, slightly rinsed in cold water and carefully fed to the fishes.

Earthworm Food. The worms should be kept a few days in moist moss, to clean themselves, then immersed a few minutes in scalding water, quickly rinsed with cold water, finely chopped, and either immediately carefully fed or dried for future use.

Dried Liver Food. Liver is boiled and either dried in a low heat and scraped from the piece when perfectly dry; or finely minced and dried. Care must be exercised in its feeding.

Fish Roe and Flesh Foods. The roe of the sea-bass, smelt and shad is an excellent fish food. It should be freed from the membrane, parboiled, dried at low temperature, and fed either in this form or rubbed into and fed with boiled oat meal. Finely dessicated boiled fish flesh, prepared in similar manner, is also used.

Ant Egg Food. The pupæ of ants, known as ant eggs, may be obtained of dealers, and if crushed and mixed with oat meal or with boiled corn meal, salt, and the yolks of hard-boiled eggs, make a most nutritious and readily digestible food. They may also be fed in the dry state.

Egg Food. The yolk of boiled eggs, mixed with any of the farinaceous foods, preferably oat meal, is an often used food. Also granulated water crackers into which beaten raw eggs are mixed and thoroughly dried, make a good food.

Mixed Foods. Milk curds, corn meal, boiled rice flour and eggs, with their finely crushed shells, together with hard biscuit or water-crackers, make a nutritious food. It should be perfectly dry, and crumbled when fed.

STARCHY FOODS. Of the farinaceous foods, vermicelli, egg noodles, and the breakfast cereals are all to be recommended and when varied with those containing animal substances, all sparingly fed, will not only nourish the fishes but produce growth and vigor, and furnish the necessary variety of diet.

Many combinations may be prepared from the foregoing list; the best being those which contain animal, crustaceous and starchy ingredients, together with some digestible form of lime, preferably, the cuttle-fish bone used in bird cages, or finely powdered egg-shells, table and epsom or glauber salts; which, in combination, will furnish all the chemical constituents necessary to the health, growth and full development of animal life, together with a mild laxative necessary to animals in confinement and deprived of the laxative salts abundant in the natural environment. Some successful fish culturists supply the salts and lime to the aquarium water by adding an occasional pinch of a powder composed of ⅓ table salt, ⅓ epsom salt and ⅓ plaster of paris.

A considerably used German goldfish food consists of these ingredients: 5 ounces of pea flour; 4 ounces of rice flour; 2 ounces of dried and powdered fish flesh, (herring); ½ ounce of finely dessicated dried meat fibre, (beef heart); 1 ½ ounces of ant-eggs (pupæ); 1 ounce of dried powdered prawn, (shrimp) or lobster; 2 ounces of dried daphnia; two raw eggs, together with the powdered shells; ¼ ounce of table salt; ⅛ ounce of epsom salt and sufficient gum arabic in boiling water to bind the mass; thoroughly kneaded into a thick dough, dried at low temperature, and crushed into convenient small particles. This makes about a pound of dried food. In feeding, the granules are steeped in lukewarm water and immediately fed; or they may be forced through a colinder, or other device to produce a vermicelli form. In the opinion of the author this food has rather an excess of animal substances.

It must always be kept in mind that a variety of food is beneficial, fed only in sufficient quantity to satisfy the hunger of the fishes, and none left over after the meal to cause contaminations in the water, or to form a culture medium for the ever-present spores of Saprolegnia, the fungus which produces the most general external disease of fishes, or breeding places for other external and internal parasites.

When Daphnia can be obtained they should be fed to the exclusion of any other form of live or artificial food, not only to the goldfish but to almost all the other freshwater fishes that can be kept in the aquarium. By their use the most vigorous growth will be obtained and the least trouble had with the aquarium and its contents. This is the unanimous opinion of expert aquariists.