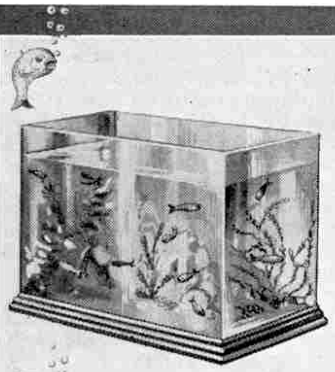


How to Start an Aquarium.

by

W. COLES-FINCH

(Resident Engineer, Chatham etc. Water Co.)

I. GENERAL HINTS

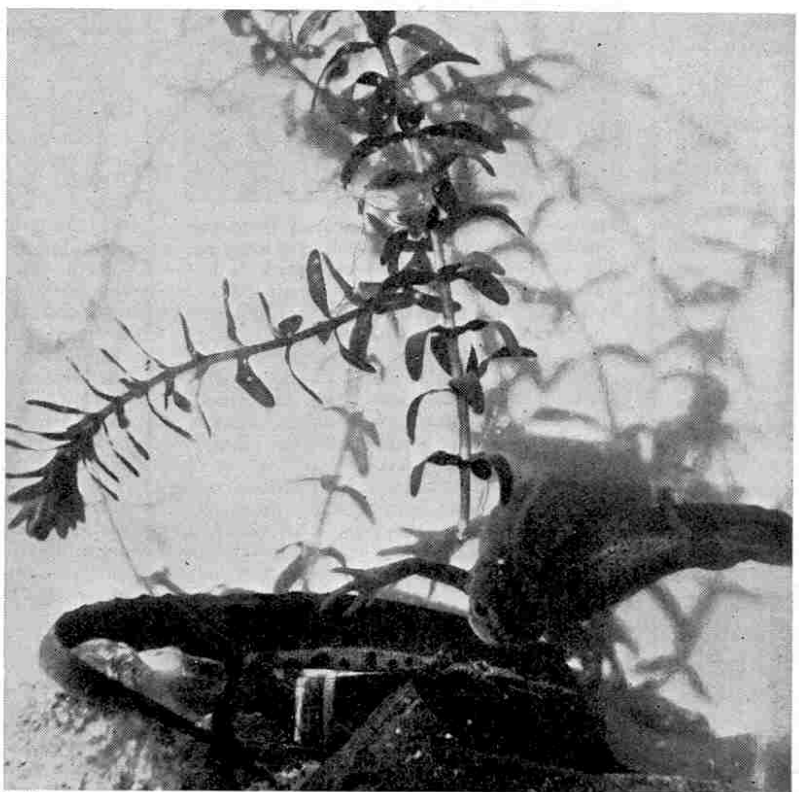
PROVIDED the necessary few minutes each day are devoted to the keeping of a fresh water aquarium, no hobby affords so much interest with so little trouble. Unfortunately there is a general impression that, given a tank or a bell glass and a few fishes, a satisfactory aquarium is an accomplished fact. Alas for the poor fishes! Under such conditions they are condemned to a lingering death. If a student of pond and river creatures were to raise a protest against "cruelty to fishes" most people would certainly think he had "a bee in his bonnet." Nevertheless it is a fact that much cruelty is unwittingly inflicted on these delicate creatures.

Cruelty to Fishes

We frequently see live fishes offered for sale in our shops. They are generally accommodated in an inverted bell glass which is placed in as prominent a position as possible in the shop window. The result is that in summer the sun's rays beat down upon the fishes during a considerable part of the day and the unfortunate creatures, having no shelter from the glare, get no seclusion or rest. We shall probably notice also that small pieces of biscuit and other food lie at the bottom of the tank, polluting the water, and as a general rule there is an entire absence of plant life without which the fishes cannot thrive.

In this tank of exhausted water the fishes swim round and round with painful weariness, their mouths skimming the under surface of the water. Day by day they linger through their miserable lives until a purchaser buys them when we can only hope that a better fate awaits them, which assuredly will be the case if they fall into the hands of one who knows how to tend and care for his new pets. Even with the best care, however, it is possible that many of the fishes will not survive long on account of the injuries already inflicted upon them by the neglect to which they have been exposed.

The reader will probably ask what is meant by "exhausted" water, why the fishes need protection from the direct rays of the sun, and why they skim the surface of the water. The answers to these questions are interesting and of great importance if the correct method of maintaining an aquarium is to be understood.



Photo] [*W. Coles-Finch*

Canadian Water-weed
Notice the beads of oxygen on the leaves of the plant

How Fishes Breathe

Everybody who has watched fishes swimming about in an aquarium has noticed that they ceaselessly open and close their mouths. It is quite natural to think that in doing this the fishes are drinking water, but as a matter of fact they are breathing. The water is received by the mouth of the fish, driven to the gills by an action similar to that of swallowing, and expelled through the gill openings. During this process the delicate membrane of the gills takes up from the water the oxygen necessary to the life of the fish. It is important to understand that the oxygen consumed by fishes is not the oxygen that forms one of the chemical constituents of water, but is contained in the air that is dissolved in the water.

Having made use of the oxygen breathed in, fishes exhale or breathe out carbon di-oxide (carbonic acid gas) just as we ourselves do. This carbon di-oxide is the main food of growing plants which, by the aid of sunlight, break it up and utilise the carbon, along with water and a small quantity of mineral constituents, to build up their structure, afterwards giving out the oxygen that remains. Thus fishes breathe in oxygen and breathe out carbon di-oxide, while the aquatic plants absorb the carbon di-oxide and return oxygen to the water. In other words the fishes and plants in an aquarium supply one another's needs and in order that life in the aquarium may proceed on sound lines a balance must be effected between the plant and the animal life.

"Exhausted" Water

This brings us to the

question of "exhausted" water, that is water exhausted of the life-giving oxygen. This exhaustion is caused by having too many or too large fishes in the aquarium, with the result that they use up the oxygen faster than it can be replaced by the water plants and faster than the water surface in contact with the air can replace the supply. When this condition arises the fishes are driven to the surface of the water for air, and the fact that the little creatures are doing this is an infallible sign that the water is incapable of supporting its inhabitants and that they are suffering.

In such a tank the conditions are very similar to those that would exist if we were forced to breathe the same air over and over again. The terrible consequences of such a state of affairs may be realised by recalling the awful tragedy of "The Black Hole of Calcutta." In 1756 Suraj-ud-Daula, the Nawab of Bengal, captured Calcutta and at the point of the sword drove 146 Europeans into the guardroom, a chamber barely 20 ft. square and having only two small windows. The result of crowding so many people into such a small room was that the air quickly became exhausted of its oxygen and unfit to support life, and next morning when the room was opened only 23 of the prisoners were found alive!

Renewing the Supply of Oxygen

When the fishes in an aquarium show by coming to the surface of the water that there is a shortage of oxygen, prompt steps must be taken to remedy the evil. First the number of the occupants of the aquarium must be reduced. Then a portion of the water should be drawn off and replaced by fresh water or the water should be aerated by injecting air, as will be described in a later article. The tank should then be watched carefully for some time to make certain that good conditions have been restored before the fishes that have been removed are replaced.

Fishes that have been negligently treated should not on any account be bought for an aquarium. The unnatural breathing of atmospheric air instead of air dissolved in the water is liable to set up inflammation in the delicate gills of the fishes and the little creatures will not recover from this malady. Fishes should be bought only from those who understand and care for them and who may be relied upon to supply only healthy specimens.

Shade for the Fishes

Fishes cannot thrive if they are always exposed to the glare of sunlight. They need shade and seclusion, which, in their natural surroundings, is provided by various plants overhanging the pond or stream in which they live. Further, out in the open the sun's rays strike downward only, whereas in a glass bowl the illumination comes from all points and this is very trying to the fish. It is necessary therefore to provide some means of shading the aquarium from too much sunlight.

Another source of trouble in an aquarium arises from leaving unconsumed food in the tank, where it turns sour and quickly poisons the water.

Starting an Aquarium

When you have finally decided to start an aquarium the first thing to do is to obtain a tank or bell glass. Do not be persuaded to purchase one of the fashionable fish globes, for everything placed in these globes is distorted in appearance, so that the inhabitants are never seen as they really are. If your tank has putty or paint likely to come in contact with the water it should be given a coating of shellac and spirits of wine, obtainable from a chemist. This coating is impervious to water and will securely seal up any impurity.

Next procure from the nearest builder's yard a small quantity of pea-gravel or coarse sand, scald it, wash it, and rinse it with clean water and then place it in the aquarium. If the tank is small a rockery is not advisable because it displaces too much of the more necessary water. If desired, however, a few pieces of rough vitrified brick may be cemented together and used for this purpose.

The next step is to visit a local stream or pond and collect some suitable water plants, which should be washed clear of mud. If your selection includes the Canadian Water-weed, starwort, mare's tail, or other trailing varieties, gather the plant up into small bunches, attach each to a piece of broken flower-pot and bury this in the sand to act as an anchor for the plant.

Filling the Tank

Stand the tank near or in front of a window where, without inconvenience to the household, it can receive light and yet at times be shaded by a blind or otherwise until the plants have grown sufficiently to afford the necessary shade and seclusion.

The tank should then be filled with clear spring, stream or rain water, or failing these, water from the domestic tap. The water should be poured very gently into the tank so as not to disturb the sandy bottom or the plants. However carefully this is done, however, the water will no doubt be cloudy at first, but it will soon clear. By means of a thin rod or pencil the plants should be assisted to spread themselves gracefully and naturally in the water. This is the first step in the stocking of an aquarium.

Need for Patience

The time is not yet ripe for the purchase of the fishes, and it is necessary to be patient for a while if success is to be assured. The plants must be carefully watched and their progress noted. When, by indications of natural growth and form, they show signs of thriving, or when streams of silvery beads of oxygen rise from their leaves to the surface of the water, we may be sure that all is well. Another visit may now be made to the pond or stream for the purpose of collecting a number of water snails which should be placed in the tank. These snails will act as the scavengers in our aquarium, their occupation being to eat the confervoid growth that forms on the glass of the tank, as well as decaying portions of the water plants.

Introducing the Fishes

The object of first establishing plant life is to ensure that when the fish are placed in the tank they will be in a healthy environment. Just as the trees and plants of our land live and thrive on carbon di-oxide and give back to the atmosphere the life-giving oxygen, so in our miniature water world the plants prepare the water for its occupants.

In our next article we shall give instructions how to make a glass tank and later articles will deal with suggestions in regard to the best and hardiest fishes with which to stock the aquarium, together with methods of aeration, feeding, and other necessary matters to help the lover of aquatic creatures to attain success in the management of his aquarium.

Matched Headphones

As everyone knows headphones are the most important part of a Receiving Set, and because of the extremely minute currents with which they are expected to operate, they must be of great sensitivity. Too little attention is paid to getting both receivers of a double headphone exactly matched in tone. This is a very important point for with unmatched receivers a signal sounds differently in one of the receivers than in the other. In the case of faint signals it would really be better if one of the receivers did not operate, as the user unconsciously concentrates his attention on the receiver giving the louder signal, and thus loses the value of the second 'phone.

To those readers who wish to get the very best out of their sets, the "Matched Tone" Headphones (made by Messrs. Brandes Limited, 296, Regent Street, London, W.1), should particularly appeal. The 'phones are matched with an ingenious apparatus that secures the same tone in strength and sensitivity to within five degrees. Signals in each therefore sound exactly alike, and in this way even the faintest signals are clearly heard and free from 'mush.' Brandes' Matched Tone Headphones are so well made that they are not easily thrown out of adjustment, and there are no moving parts to wear out.

We recommend all our Radio readers to send to the makers for a booklet giving full particulars of these 'Phones. On request the firm will also send particulars of their Table Talker, an instrument which, both in quality and price, should appeal to owners of valve sets.

Competition Results

(*See page* 307)

Sharp Eyes

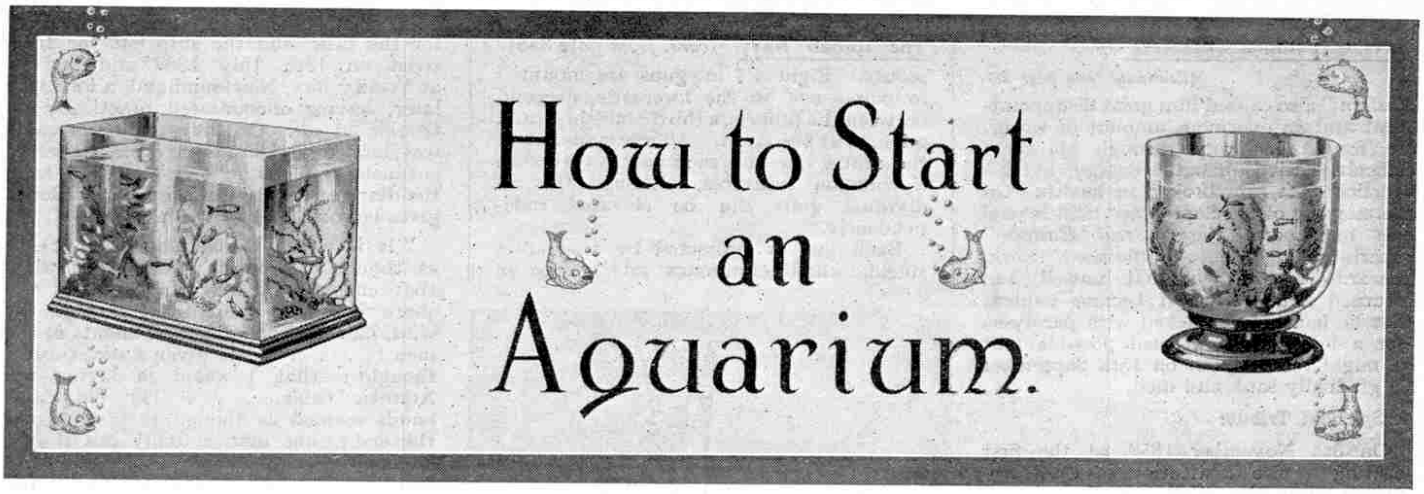
The drawing of the motor-car, horse and trap, and steam-roller in their somewhat bizarre surroundings brought in a vast shoal of lists of mistakes. In common with many competitors in the Home Section of this contest, a large number of entrants pointed out the absence of fittings on the vehicles that could not possibly have been visible to anyone on the side-walk where our erratic artist installed himself. Other competitors could have saved us trouble by checking their own lists and deleting items entered more than once. Another difficulty in judging was caused by the use of foreign or colonial terms for items on the drawings, particularly in regard to the motor car.

Long and patient scrutiny and correction have resulted in the final award of the three prizes offered as follows:—First Prize (Hornby No. 2 Goods Set), Harold Turner (Hastings, New Zealand). Second Prize (Hornby No. 1 Goods Set), Bertie Graveur (Sydney, New South Wales). Third Prize (Meccano No. 1 Radio Receiver or Double Headphones), R. V. Shutte (New Brighton, Christchurch, New Zealand).

"Bargain Hunt"

It was interesting to find the Overseas entrants for this contest arriving at a different verdict from that of our home readers. To decide from the voting the first in order of popularity of our advertisers was not difficult, but two firms tied for second place and very little behind them came the third. Votes were carefully counted with the following results:—(1) Nelson T. Hillier (Horsmorden); (2) Messrs. Witherick (Coventry) and Messrs. Watkins (Barnet) a tie; (3) Messrs. Lisburn & Townsend (Liverpool). One competitor, Jack Weatherway, Brantford, Ontario, sent in a correct entry and to him is awarded the first prize of stamps to the value of £1/1/- to be chosen from the list of any firm advertising in the "Meccano Magazine." Prizes of a free advertisement in the "Meccano Magazine" to advertise their own wants or sales are awarded to C. W. Watkins (Sydney, N.S.W.); Arthur Wilson (Hamilton, Ont.) and H. V. Reynolds (Georgetown, British Guiana).

The two consolation prizes awarded by Nelson T. Hillier for the two best runners-up under and over 12 years of age have been won by V. Sammie (Trichinopoli, S. India), collection of 1,000 different stamps, and Stan. Hutchinson (Ebendale, New Zealand), Standard Catalogue of postage stamps (1925 edition).



How to Start an Aquarium.

By W. COLES-FINCH
(Resident Engineer, Chatham etc. Water Co.)

II. BUILDING A TANK AQUARIUM

LAST month we gave an outline of the methods that must be adopted in order to make an aquarium of any kind a success. Since that article appeared, many readers have written to ask for instructions for making a more satisfactory aquarium than a simple bell glass, and therefore we give this month a detailed description of a type of tank that has been used by the writer for over 40 years, and has never leaked or given the slightest trouble of any kind.

Slate Foundation

The bottom is of slate (A, Fig. 4). Any builder will saw a suitable piece from some derelict slab in his yard and prepare it at a small cost, or will supply a piece of new slate, drilled and sunk for uprights or columns, grooved to take the glass and with holes bored for fountains and overflow pipes (B, Fig. 4).

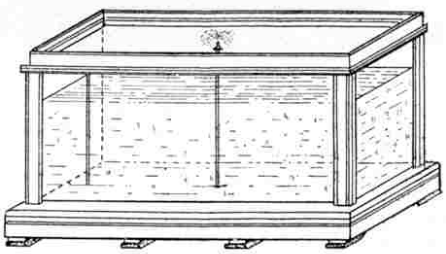


Fig. 1. Elevation of Tank

Four angle columns of iron or brass grooved for the glass are now required (C, Figs. 3, 5, and 6). These must be provided with iron or brass studs at each end (D, Fig. 6). This may sound rather formidable, but any ingenious Meccano boy can make a wooden pattern for one column and a local metal founder will cast four at a small cost. If desired, their appearance may be improved by machining or draw-filing.

The next item is the wooden framing for the bottom, placed beneath the slate slab to give it support and to form a fixing for the mahogany moulding of the tank (Fig. 2). This framing is of ordinary well-seasoned fir, 2½ in. by 1½ in. The top framing should be of 1½ in. by 1½ in. mahogany (F, Fig. 3), and grooved for the glass as shown (G, Fig. 3). There should be little difficulty in mortising these frames together and ploughing the necessary grooves.

The stud ends of the columns pass through the slate and wooden bottom framing, and through the mahogany framing of the top, the washer and nut at both top and bottom being let flush into the framing (H, Figs. 3 and 5).

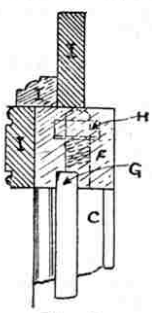


Fig. 3. Detail of Top

Bedding the Glass

Those to whom cost is of no importance may purchase four squares of ¼ in. polished plate glass from a glazier, but a builder probably will be able to supply the glass cheaply from the wreckage of some shop front. It will not matter if the glass is slightly scratched for this will not readily be discerned when the tank is filled with water.

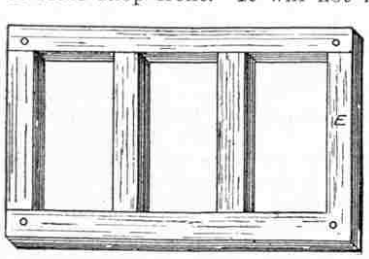


Fig. 2. Base for Slate

The glass should not be cut to size until the parts of the tank have been tried together and definite measurements taken. It would be wise to ascertain the thickness of the glass available for the purpose, however, and to make the grooves in slate and columns 1/16 in. fuller than the glass. The glass should be bedded in the slate grooves and columns with liquid red lead and gold size.

All that remains is to encase the top and bottom framing of the tank with moulded or beaded mahogany fillets, carefully mitred at the angles and fitted round the columns (I, Figs. 3 and 5). The help of a joiner may be advisable in this final stage of the work. The tank is then complete.

If the woodwork is carefully French-polished the tank will be one of which the owner may be justly proud. It will be worthy of a place in any room and if carefully stocked and given the little attention an aquarium demands it will be a source of never-ending pleasure.

In the matter of reliable controls for the fountains and unions for passing pressure water and overflow pipes through the slate bottom, a plumber should be consulted, but nothing difficult presents itself in this matter.

It must be borne in mind that considerable strength is necessary in the construction of a tank, for each cubic foot of space will hold 6¼ gallons of water weighing, say, 62 lb. The tank suggested has an inside measurement of 28 in. by 16 in. and is 13 in. deep. If filled to a depth of 12 in. it will contain some 19 gallons of water weighing 1¾ cwt., and yet it is by no means a large tank.

Importance of Surface Area

One important point making for success in an aquarium is that surface area must never be sacrificed to greater depth, for the amount of the life-giving oxygen taken up by the water is in proportion to the area of the surface of the water exposed to the atmosphere. For this reason it is suggested that, although the tank is 13 in. deep, no more than 9 in. or 10 in. of water should be placed in it. The additional depth is allowed in order that the floating plants may better be seen at the surface and that certain of the pond creatures may not readily escape.

Were it not for purposes of observation, the tank would be a more desirable habitation for its occupants if the back and both ends were also of slate, leaving only the front of glass. This objection may be readily overcome, however, by arranging curtains on three sides of the tank, to be drawn when desired. These curtains may be fixed on a brass rod or wire attached to the moulding at the top of the tank, and by this means judicious shading is easily obtained.

The dimensions of the tank may be varied to suit individual requirements, but due consideration always must be given to the thickness of the various materials used in its construction.

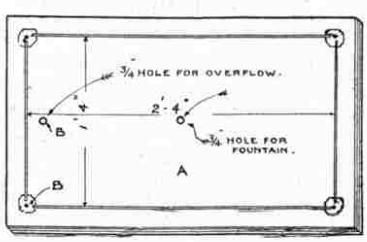


Fig. 4. Grooving of Slate

The particulars here given form a reliable guide in this respect.

Arranging a Fountain Jet

If it is considered too elaborate a business to connect town's water (under pressure) to the tank, a substitute may be arranged. Upon any high shelf near by, or in the room above, a small open tank may be fixed and from this a ¼ in. "compo" tube carried to the fountain inlet. A pail of water could then be siphoned from the aquarium and a pail of fresh water poured into the higher open tank, and this water, in the form of a tiny jet, would give a short but pleasing display adding greatly to the delight of the occupants of the tank.

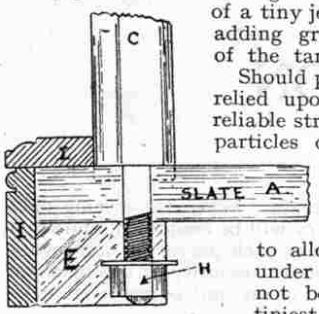


Fig. 5.
Detail of Bottom

Should pressure water be laid on and the overflow relied upon to govern the level of the water, a reliable strainer should be provided to keep floating particles of water plants or food from choking the overflow, with the unpleasant result of flooding the room. The writer has good reasons for suggesting that it is well to decide never to allow a pressure water jet to play except under close observation. Certainly it should not be left for a week-end, even with the tiniest jet playing, trusting to the overflow to regulate the level of the water. Many things may happen during one's absence!

NEXT MONTH:—

SOME SUITABLE FISHES

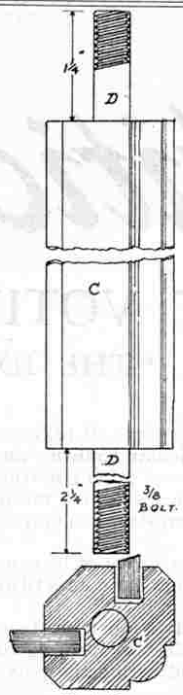


Fig. 6.
Detail of Column

New Wonders of Wembley—

(*Continued from page* 353)

and New Zealand, Ceylon, Burma, Newfoundland, Malaya and the Africas have all reopened with increased spendour.

In the Hong-Kong section one is invited to lunch from real Chinese fare, which includes bird's-nest soup, "sam-shi" of shark's fin, lychees, curnquet chow-chow and melon seeds. I did not consider that my taste was sufficiently educated for such delicacies, however, and departed in search of the more prosaic menu of our English restaurants!

Perhaps one of the great fascinations of Wembley is the fact that, at every turn, one never knows quite what to expect, for all kinds of weird and unusual objects are suddenly encountered in out-of-the-way corners. It is never wise, for example, to offer bread or choice buns to the stately swan that rides so gracefully near the edge of the lake, for one usually gets almost vexed at the aloofness and cold disdain with which he treats such tempting morsels, before discovering that he is made of wood! And it is just as one makes the discovery that everybody near laughs—probably because many of them have been similarly caught! It is also somewhat trying for the nerves, as one glides over the lake in an electric launch, to be suddenly confronted with a huge crocodile, apparently about to slip into the water from one of the banks. Again, imagine the havoc created amongst one's sisters when suddenly meeting half-a-dozen frogs, or toads, each about two feet in length, and all breathing from their throats in the correct batrachian fashion! Of course, being a Meccano boy, I always look for the "why and the wherefore," and quickly noted the partly concealed pipe connected to each frog that causes such a realistic impression.

New Rolling Stock for L.N.E.R.—

(*Continued from page* 347)

catch on the garnish rail. A lifting bar is fitted on the light and the customary lifting strap is, therefore, omitted.

All the doors are fitted with "Kaye's" patent wedge locks, with safety catch on the inside handle.

Interior Finish

The interiors of the compartments are finished in varnished teak, the ceilings being covered with millboard. Advertisement frames of varnished teak are placed above the seat backs.

Woven wire seats are used throughout. The seats in the first class smoking compartments are upholstered in leather, and those in the first class non-smoking compartments in best blue cloth. The seat front rail is faced with leather cloth. No buttons are used.

The seats in the second class compartments are upholstered in crimson carriage pile cloth, and those in the third class in leather cloth.

Spring blinds are fitted to each quarter, and there are two standard 4 in. torpedo ventilators in the roof of each compartment.

Each vehicle is equipped with passenger communication apparatus.

The carriages are finished outside in varnished teak, the underframes being painted teak colour, and the ironwork details finished in black japan.

OUR MAIL BAG

A. Landell (Montreal).—You have certainly taken a long time to write to us, but now that you have broken the ice we hope to hear from you regularly. Your experience of mumps was certainly trying, but we hope by this time you have recovered. You appear to live in a warm quarter, with fires in front and behind your house. We hope that by now you have your Meccano fire alarm installed. Why not keep a Meccano fire escape handy in case of emergencies?

R. Cose (Christchurch, N.Z.)—We are glad to welcome you back to the fold. There is joy in Meccanoland over the return of each one of the few misguided ones who leave our sunny shores. We are sorry we are not able to use your article, as we recently published one on the same subject. We hope you will try again.

A. G. Carnacho (Georgetown, Demerara).—We are pleased to hear that your No. 7 Outfit keeps you happy and busy. Guild literature is being posted to you separately.

G. H. Pollard (Leeds).—We know your city well, and the glorious country round it. Why should you be too frightened to write to us—We never heard of such a thing! We shall expect to hear from you regularly, George.

G. Howard (Mosgiel, N.Z.)—We were interested in reading your account of your camping out experiences in the South Island, and we look forward to receiving your snapshots. We had already heard of the epidemic of Infantile Paralysis in New Zealand, which we hope has now abated.

T. S. Nagi (Amritsar, India).—Under separate cover we have sent you a list of Guild members, and we hope your efforts to form a club will meet with success. Competition entry received.

H. G. Slade (London).—Thanks for your suggestion for attaching wheels to locos. The new Hornby Electric Loco, which will soon be on the market, has wheels fitted in this way. The idea is quite sound, but of course not new.

T. Appaduray (Perak, Malay States).—One of the most useful sides of the Meccano Guild's activities is the encouraging of friendliness between boys of all countries by means of its Correspondence Club. We are pleased that you are making such good use of the club and that you enjoy the letters that you receive.

V. H. Alpe (Kandana, Ceylon).—"I have a great desire to see the Meccano Factory, but I suppose I should require a sort of Magic Carpet to do that. I doubt if I shall ever have a chance of coming to England. I shall have to be contented with looking at it through Dick's eyes. Thanks to Meccano I shall soon have a new chum in England." At all events through the "*M.M.*" you are kept posted regarding all the doings in Meccanoland, and this we are glad to see gives you pleasure. Who knows but what the Magic Carpet may some day come along your way and ship you over to us? More wonderful things than that have happened.

R. B. Sibson (Cliffe-at-Hoo).—We are pleased to note your keen interest in the study of nature. We hope to publish further bird articles. You would probably find pleasure in reading White's "*Natural History of Selborne*," and some of the fine books written by the late W. H. Hudson.

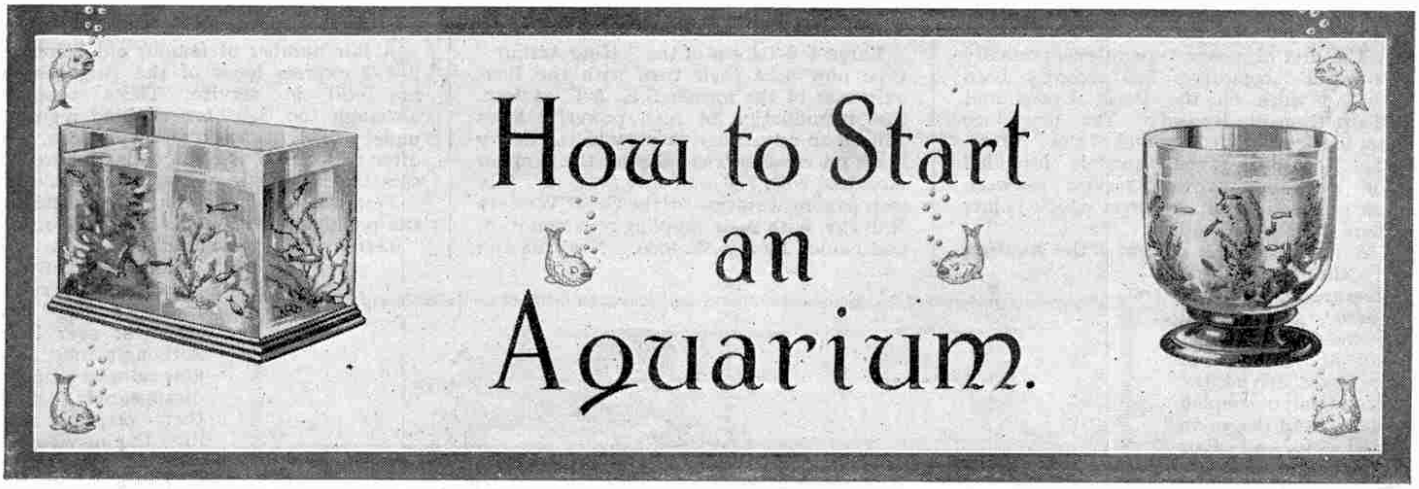
G. F. Raynor (Cholsey).—Most fathers are just like your own. They say what a wonderful publication the "*M.M.*" is for boys, and then they proceed to read it all through themselves! The same kind of thing happens with Meccano and Hornby Trains. It's just as well, anyhow, because its a fine thing for fathers and sons to have common interests.

N. Fraser (Canterbury, N.Z.)—Wiseman's Meccano Club with its 710 members, is amongst the most successful and the biggest in the world, and you are lucky to be a member of it. Thanks for interesting snapshots.

E. Green (Torrensville, S.A.)—You seem to be a fine sturdy Meccano boy judging by your photograph. We hope you will make full use of the Guild Correspondence Club.

Keith Boothby (Clarence River, N.S.W.)—Many thanks for the two copies of the "*Sydney Mail*." The pictures were interesting and excellent. Your cricket record is a fine one, and in a few years' time we shouldn't wonder if we saw you over here with the test team. We shall give your fellows a great welcome next year, and we shall try to treat them as well as you treated Hobbs, Sutcliffe and Co.

T. Pattle (Keetmanshoop, S.A.)—"We are having glorious rains here just now and the country is looking beautiful." We have rain most days, Tom, but we rarely call it glorious. We are sorry for the mistake in the Overseas Closing Date for the Competition and we will see that this does not happen again.



How to Start an Aquarium.

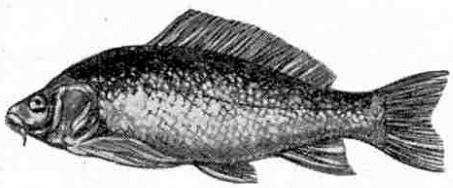
By W. COLES-FINCH

(Resident Engineer, Chatham etc. Water Co.)

III. SOME SUITABLE FISHES

HAVING filled and prepared the tank on the lines described in the article published in the May "*M.M.*," the water should be bright and clear. If the plants are thriving, they should give off beads of oxygen from time to time, which rise to the surface of the water in a silvery stream. When we see this, we may rest assured that all is well and if fishes are introduced there will be no distressing indications of suffocation by the little creatures swimming with their mouths close to the surface, as already described.

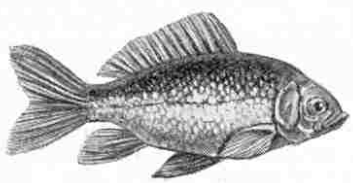
The great factor to be borne in mind is proportion—that is, a small aquarium demands small inmates. Nothing is more unsatisfactory from all points of view as a small aquarium overstocked with fishes that are too large and unable to move about more than, say, three times their own length in any one direction. It is far better to have small fishes, for to watch these darting about here and there pleases the eye far more than the sight of one large creature moving slowly and sluggishly only a few inches.



Common Carp
(*Cyprinus carpio*)

Hardy Fishes

There are many kinds of fishes that are suitable for the tank, but our first experience should be gained with the more hardy specimens. Golden Carp (*Cyprinus auratus*); Common Carp (*Cyprinus carpio*); Prussian Carp (*Cyprinus gibelio*), and a little group of the graceful Minnow (*Leuciscus phoxinus*) should suffice excellently for a time. These fishes must of necessity be small and few in number, for any attempt to crowd the tank is certain to result in failure. The thing to aim at is not a tank of imprisoned fish, but rather a miniature portion of a typical stream, with its thriving plants and healthy inmates.

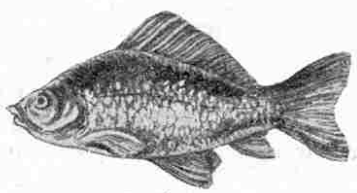


Golden Carp
(*Cyprinus auratus*)

Later, when the first fishes have settled down comfortably and made themselves at home, and if there is yet room to spare, a couple of Golden Orfe (*Leuciscus orfus*) might be introduced. These fishes are of lemon-gold colour, slim and graceful, quick in movement and superior in many ways to the sluggish, lazy Goldfish. They deserve to be much better known, for they are hardy, and the writer kept a pair of them, in company with other fishes, in his aquarium for ten years. At first they were tiny creatures about two inches in length, but they grew until they became too large for their home and they were then placed in a garden pond, where they lived for several years.

Refreshing the Aquarium

Even if the balance of plant and animal life in a tank is satisfactorily maintained, as described in our first article, it is desirable occasionally to take a little water from the tank and replace it by fresh water. Both operations should be carefully carried out by the use of a small siphon. Emptying the tank entirely should be carefully avoided. The shock due to the change of temperature alone is very distressing to the fishes and there is also the general disturbance of the plants, which checks their growth and upsets their natural form and beauty. A small syringe may be brought into use at times to revivify the water by withdrawing some of it and squirting it back again with as much force as possible. This operation has the effect of driving air under the water, which takes up the oxygen and thus becomes more fit to support life.



Prussian Carp
(*Cyprinus gibelio*)

If the glass becomes dull by reason of too much confervoid growth—probably induced by too much bright light—the natural growth of the plants will be checked. In this case the excessive growth may be removed quite easily by means of a toothbrush or a piece of sponge attached to a stick.

Food for Fishes

Fishes need very little food. Some of them are more particular than others, but generally speaking ants' "eggs"—which are really the pupæ of the ants—are welcome, forming excellent food.

Other suitable foods are finely chopped shrimp, raw meat, hard-boiled egg, small worms, or finely broken vermicelli. Small crustaceans and larvæ and pupæ of water flies from ponds and ditches would be a luxury but they are not a necessity. The eggs and fry of the water snails living in the tank also provide wholesome food for the fish.

Minnow
(*Leuciscus phoxinus*)

An Unpleasant Experience

In reference to ants' "eggs," care should be taken to make certain that they have been "kiln-dried" and their fertilisation destroyed. A sixpenny box of "eggs" once cost the writer £15! They had not been correctly prepared, and the whole lot hatched out and took up their residence behind the skirting board beneath the floor of the room!

At night the ants came out in battalions and covered the walls of the room, disappearing when daylight came. Every effort to get rid of them failed. As fast as some were killed a still greater number filled their ranks and nothing seemed to have any effect on them. Finally floors and skirting had to be taken up and the walls and all cavities treated with chemicals, and in this way the ants were finally destroyed.

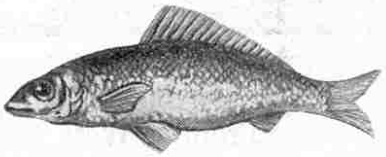
Removing Uneaten Food

On no account must small particles of food be left in the tank to decay. These particles may be removed quite easily, without disturbing the occupants of the tank, by means of a narrow glass tube, used as a "pipette." The top end of the tube is closed by pressure of the finger and the other end is lowered into the tank until it is just above the particle to be removed. The finger is then lifted and water rushes up into the tube carrying with it the offending particle. The top of the tube is again closed with the finger and the tube, with its contents, are then withdrawn from the tank.

A Pressure Jet

If a tank is of sufficient size to warrant the step, greater pleasure may be obtained and more creatures kept in healthy condition by laying on town's water. The jet, which need be no larger in diameter than a darning needle, may be turned downward so as to impinge upon the surface of the water. This tiny pressure jet will drive a stream of silvery air bubbles far beneath the surface of the water and the Minnows will gambol and rush up the glistening track in the most delightful manner. The downward jet may be removed and a fountain jet screwed on at will.

Such a jet provides a splendid means of aerating the water, but it does not obviate the necessity for maintaining healthy conditions by means of plant life. The jet merely enables an increased number of inmates to live in the tank and makes easier the task of balancing the vegetable and the animal life.



Golden Orfe
(*Leuciscus orfus*)

Under these favourable conditions and when more experience has been gained, we may introduce Gudgeon, Chub, Stone Loach, Rudd and the sluggish Tench. It will be fatal to the small members of the aquarium, however, if large specimens of these fishes are introduced among them. A fish in doubtful health should never be placed in the aquarium, but should be kept in a separate vessel until there is no doubt that it is healthy and above suspicion.

A Word of Warning

One word of warning must be given here. No risk should be taken by indiscriminately placing in the tank every aquatic creature that comes to hand, otherwise it may be discovered, all too late, that wolves have been placed with lambs, with an obvious and unfortunate result! For this reason it is not wise to risk the presence of water bugs, beetles or scorpions among the peaceful members of the tank until some knowledge of their various habits has been attained.

Over-feeding is bad for fishes and must be carefully avoided and, as already stated, any particles of food not consumed should be removed immediately before they have time to decay and pollute the water.

On the other hand, if fishes are not sufficiently fed they may be driven to cannibalism or to devour and exterminate smaller and weaker specimens of other species.

NEXT MONTH:—

POND LIFE IN THE AQUARIUM

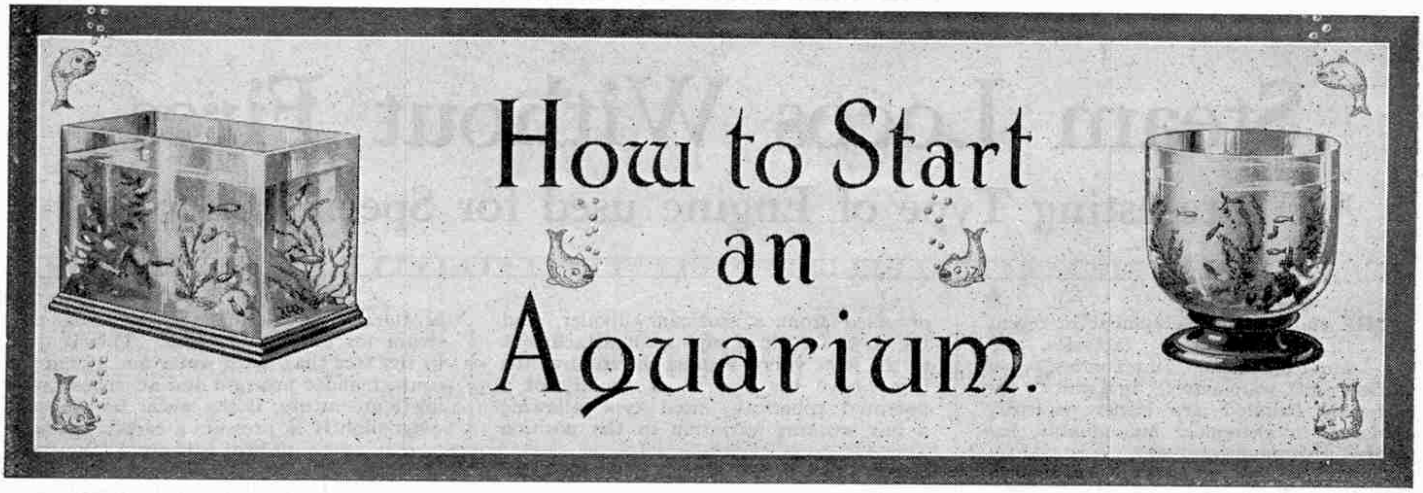
The Highest Structure in the World

(*Continued from page* 385)

It was one of the first models, and although it has been improved on several occasions, it necessarily retains many of its original features. In fact, it is one of the few models that have not been improved out of all recognition from the early days of "Mechanics Made Easy." The model has appeared in Meccano advertising, on Outfit labels, and in other printed matter for many years, and in this manner has reached every civilised country in the world. It has even been said that were Meccano Limited ever to adopt a trademark, the model of the Eiffel Tower would admirably serve the purpose.

The construction of the model requires very little description, because it is so clearly evident from the accompanying photograph. As is the case in the real Eiffel Tower the Meccano model carries a lift electrically operated by the Meccano motor mounted at the base. The lift-carriage is raised or lowered by a sprocket chain, which passes over a sprocket wheel at the top of the tower, mounted on a rod journalled as shown in Fig. A. The sprocket chain is driven by the motor through worm-gearing as shown in Fig. B. The lift-carriage is guided by cords stretched from the top to the bottom of the tower.

The two detailed views make the construction quite clear and there should be no difficulty whatever in building this model, which is capable of further improvement and elaboration—as, for instance, the fitting of an automatic reversing switch to mechanically reverse the motor when the lift-carriage reaches the base of the tower, and to operate it again when the carriage reaches the top of the Tower. Other elaborations will readily occur to our readers.



How to Start an Aquarium.

By W. COLES-FINCH
(Resident Engineer, Chatham etc. Water Co.)

IV. MORE SUITABLE FISHES

IN the previous article illustrations were given of and reference was made to those specimens of fishes with which to first stock an aquarium—the Carp family (*Cyprinidæ*), the Minnow (*Leuciscus phoxinus*), and the Golden Orfe (*Leuciscus orfus*). Having now gained some little experience in the management of his tank, the reader will do well to extend his interest to other hardy specimens suitable for the aquarium, presuming of course that success has so far followed his first effort and that the fish are healthy and happy in their new environment.

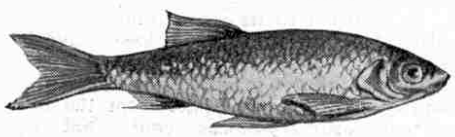
In previous issues we have dealt with the making and preparation of an aquarium and have described some of the fishes suitable for tank life. In this instalment, after dealing with a few other suitable fishes, we pass on to the fascinating subject of pond life in the aquarium, which subject will be dealt with at greater length next month.

In the writer's experience the following fishes are suitable :—Roach (*Leuciscus rutilus*) ; Rudd (*Leuciscus erythrophthalmus*) ; Dace (*Leuciscus vulgaris*) ; Chub (*Leuciscus cephalus*) ; Gudgeon (*Gobio gobio* or G. *fluviatilis*) ; Loach (*Nemachilus barbatulus*) ; Tench (*Tinca tinca* or *T. vulgaris*) and Perch (*Perca fluviatilis*).

The Roach is a general favourite, and no aquarium can be considered complete without the inclusion of a specimen of this most attractive and graceful creature. It is silvery-white, with greenish back, the lower fins usually being tinged with red.

The Rudd resembles the Roach to some extent but is deeper in the body.

The Dace is another bright-silvery fish, but more slim in form than the Roach. It is a hardy fish and has quick and graceful movements. Its name is derived from the old English " Darse " or " Dart," by reason of its peculiar darting method of making headway against a swift-flowing current.



Dace
(*Leuciscus vulgaris*)

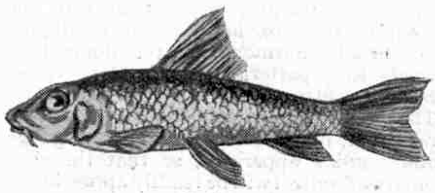
The Chub is closely related to the Dace and like the latter should find a place in the aquarium.

The Gudgeon is another fish admirably adapted for tank life. Its colour is brownish or greenish above and silvery or golden on the sides and below. Often it has small scattered brownish spots on the upper parts and a row of larger blackish spots along the middle of the side, with a series of small dark spots on the dorsel and caudal fins.

The Loaches are closely allied to the Carp family, but have an ungraceful elongate body. They are of sluggish disposition, spending most of their time on the pebbly bottom of the tank. The six barbules at the mouth give the fish an unpleasing appearance, which is very different from the generally sharp and graceful outlines of other fishes. The ugly appearance at any rate makes it easy to readily recognise the species, should its long straight body not have been a sufficient guide in this respect. The Loach should not be entirely overlooked on account of its appearance, for as a saving grace it may, in common with many other fishes, be readily tamed.

The Tench resembles the Loach in that it is a sluggish fish, spending its time in a similar lazy manner. Its iridescent scales of green-bronze, which seem to scintillate with every movement, offer ample compensation for its idle habits. It is often referred to as the " physician fish," for there is an old tradition that its touch cures the maladies of any fish with which it may come in contact. Indeed, its presence in the tank is said to keep away sickness from the other inmates. If only for the contrast they offer in company with the fishes of silvery-whiteness, the golden-tinged, olive-brown Carp and the darker bronzed Tench should be introduced in the aquarium whenever possible.

The Perch is a beautiful and attractive fish. It has a greenish-olive back, sides that shade to golden-yellow or white at the belly, and is marked along the sides with vertical bars of darker hue. It is a voracious fish, however, and does not readily adapt itself to life in the aquarium.

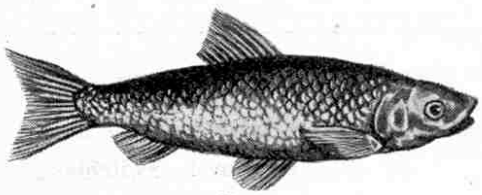


Gudgeon
(*Gobio fluviatilis*)

One final word in reference to " suitable fishes." Whenever the aquarium is large enough to accommodate them, a little shoal of Minnow should always be introduced. They are the life and soul of an aquarium, and to the writer a tank without them would present

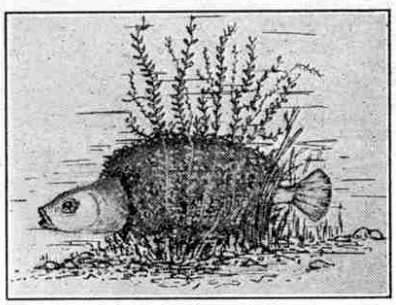
a very tame appearance.

All the fishes enumerated may be readily procured from the dealers, for doubtless the majority of readers do not live near to either a stream or a river. To those who are more fortunately placed in this respect, however, there is an added charm in capturing ones own specimens, or in accompanying an angler or fisherman with a like intent.



Chub
(*Leuciscus cephalus*)

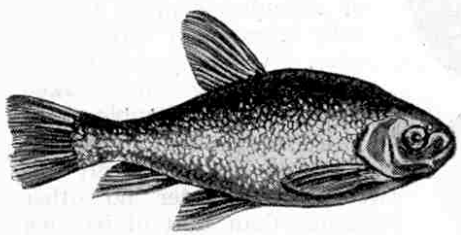
It is the writer's privilege to live near the river Medway and its delightful tributaries, and the manner in which many of his fishes are obtained may be of interest. At certain times of the year the fisherman (not the anglers) pursue their calling in the higher reaches of the river. Here, perhaps they net the delicate Smelt or other fishes that travel beyond the salt tidal waters to where the fresh water from the hills intermingles. These fisher folk are a kind and genial set of men, ever ready to help in this matter. If one gets on friendly terms with them they will readily look out for desired specimens and, when hauling in their nets, instead of throwing back into the river these little wanderers from the upper waters, place them in the "well" of the boat or in some receptacle for the aquarium enthusiast. Fine healthy specimens are often obtained in this manner.



Stickleback and Nest

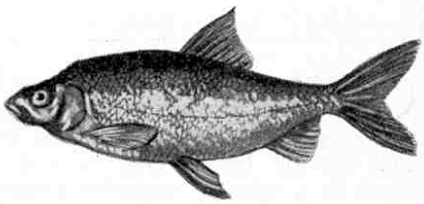
Before proceeding to deal with the introduction of pond life into the aquarium, it will perhaps be of general interest to give a few additional hints based upon a host of queries received. Several readers who have written to the Editor have failed to keep fish in their aquarium solely through introducing them before the material used in the construction of the tank had become sweet and before the plants had established themselves. In this matter the instructions given in the first of this series of articles, under the heading of "General Hints," must be strictly followed.

Other readers seem in difficulty on the matter of the temperature of the water. Provided the water never sinks absolutely to freezing point, fishes prefer cold to heat. Even if the water be ice-cold they will be perfectly happy. It may be of interest to mention an experiment to test this, but it is advisable that the reader should not attempt to repeat it unless it is convenient for him to guard against actual consolidation into ice of the mass of the water taking place, with the inevitable result of a burst tank!



Tench
(*Tinca vulgaris*)

The writer set his tank where it could be partially protected, but where a sharp freezing current of air could play upon one side of the tank only. From this exposed side long spears of ice spread out across the tank in a most fantastical manner, radiating in fanlike form, each separate spear resembling the blade of a carving knife with saw-like edges. The fishes were not unduly alarmed and appeared to be merely wondering what was happening in their home, and, in no way perturbed, they threaded their way in and out of the icy spears. Indeed, although some of the fish became entangled between the spears and plates of ice and were unable to move for many hours, when the ice melted they were no worse for their imprisonment.



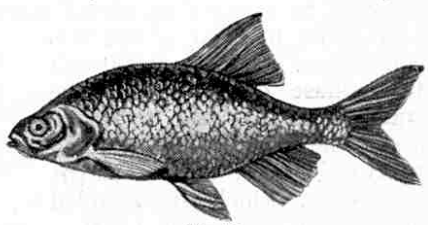
Roach
(*Leuciscus rutilus*)

Curiously enough, during this experiment no film of ice appeared upon the surface of the water in the tank. As the cold draught beat against one exposed side only, it was from this point the icy spears originated and, extending into the slightly less cold water in the other half of the tank, almost reached the opposite side.

Fish certainly prefer cold to heat, for the simple reason that the warmer the water the less its capacity for dissolving and retaining in solution the necessary gases. It is obvious that less oxygen is available under these conditions, so that the water becomes more quickly exhausted and the fishes suffer accordingly. It is therefore wise to avoid extremes of either heat or cold, maintaining as even a temperature as possible, erring in preference on the side of low temperature.

With water at a low temperature fishes become less active and less inclined to take food, but as they are undoubtedly happy, this is all that matters. In cold weather the inmates certainly demand less attention, and the revivifying of the water should scarcely be needed through the winter months, if plant life is thriving and the tank is not overstocked.

The aim should be to keep and preserve the fish in such healthy and congenial surroundings in their now diminutive water-world that they are enabled to live happily for many years. Further, by careful and thoughtful attention it is possible to train the fish so that, when one approaches the tank, the inmates will come towards the side of the tank and, as a tempting morsel is proffered, rise to the surface and take it from the fingers, or nibble at the friendly fingers in playfulness.



Rudd
(*Leuciscus erythrophthalmus*)

This should be a full compensation and reward for the little effort that has to be made to successfully keep an aquarium, and as a lover of fishes I would add: If it is not possible to devote this small amount of care and attention, do not start an aquarium, but turn your attention to a hobby in which suffering will not

(*Continued on page 527*)

How to Start an Aquarium—

(*Continued from page* 521)

be inflicted upon even a fish.

It must not be imagined that because the ditch and pond dwellers live together they are all friendly disposed towards each other. This is far from the case, and if we could see the struggle for existence that goes on in every peaceful-looking pond, we should be greatly surprised at the tragedies enacted there.

In their natural habitat the weaker species can find some shelter and protection from the more aggressive members of the community, and in the plant life of their home or in the muddy bottom, or among the stones, they have a chance to escape from their hungry pursuers. In an aquarium this is not possible, hence we have to use a wise discretion in the selection of the species to be associated in our tank.

The Stickleback is a most interesting creature, but for voracity and pugnacity it is difficult to find its match. The Stickleback should never be introduced where there are more delicate and peacefully-disposed occupants—in such a case it is safer to keep them in a separate vessel. Having prepared the tank as previously described, planted and established the various water-weeds, introduced the water-snails and as much minute pond life as possible (water-fleas, cyclops, etc.), we may proceed to instal our Sticklebacks. There should be one male to four or five females. In the spring it will be easy to recognise the male, his breast then assuming a courting colour of bright iridescent red, and at this time he will fight his male rivals with great tenacity and fierceness, raising his spines and fiercely darting at his foe.

If the tank be well provided with plant life, thus affording the necessary material for nest building, the Stickleback will proceed with this interesting part of his domestic affairs. With fibres from the plants he will construct a muff-like nest, hollow in the centre. When this is completed he entices one of the females to view his work, enter the tubular nest and deposit her eggs. No sooner is this accomplished than it is a case of "off with the old love—on with the new!" He flaunts his coloured vest and with sundry fishy wiles persuades other willing females to add to the number of eggs deposited.

Mr. Stickleback then completely ignores his wives, enters the nest and busies himself in "fanning" the water with his fins in order that it may circulate through the nest, flow and ripple over the eggs, and thus aid their incubation. With the appearance of the young fry his life becomes more arduous still, for they must be protected even from his discarded wives, who have decided cannibalistic instincts which they are not slow to put into operation!

If it is desired to witness nest-building operations, the fishes should be obtained not later than the middle of April, and there should be no disturbing the fishes and plants in a manner likely to upset them after they have been introduced to their new home.

The natural food of the Stickleback is the minute pond life and the small fry of any species of fish and in confinement these little gourmands must be well fed. Small worms—first dashed upon the pavement to kill them—pieces of larger worms, shreds of raw meat, etc. form very suitable food.

The Stickleback is not a long-lived fish in confinement, rarely surviving more than three years. The writer returns them to his garden pond at the end of each season and for the autumn and winter re-stocks his tank with the Golden Orfe, Carp, Minnows, etc., which have been given a summer holiday in the garden pond.

NEXT MONTH:—

POND LIFE

Aluminium—(*continued from page* 511).

The ore now passes through a final grinding and is then ready to undergo the main process in which the alumina is separated out. This stage of the operations is now almost universally carried out by what is known as the "Bayer" process. The calcined ore is mixed with a certain quantity of a solution of caustic soda and is then transferred to "autoclaves" which are long steel containers provided with steam jackets and stirring apparatus. The heating of the fluid by the surrounding steam produces a pressure of about 70 lb. to the square inch. Chemical re-action takes place, resulting in the formation of soluble sodium aluminate, whereas the impurities remain as an insoluble residue.

The liquor from the autoclaves is now blown out by the force of the internal pressure into large tanks, where it is diluted with washings from previous operations and then filtered in presses. The clear liquor is then stirred with aluminium hydrate. This results in the precipitation of a large proportion of the dissolved alumina as hydrate, which is separated in filter presses, washed and dried. Finally it is heated in a rotary kiln to a temperature of 1000°C., and in this operation the alumina is transformed from amorphous to crystalline formation.

Electrolytic Reduction

The pure alumina thus obtained must now undergo further treatment in an electric furnace to reduce it to aluminium metal. The only process in use at the present time for this purpose is the Héroult-Hall process, which was introduced in 1890. A current of from 2,000 to 20,000 amperes at 5 to 8 volts is used.

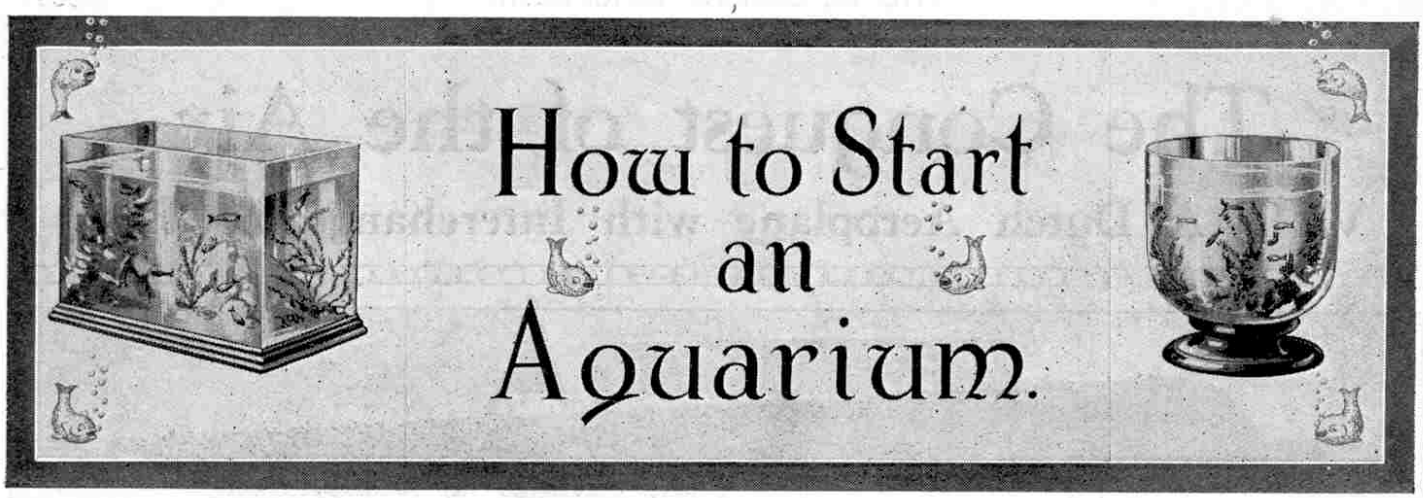
The process really consists of electrolysis carried out at a very high temperature. The current plays a two-fold part, acting as a heating agent to keep the electrolyte in a state of fusion while at the same time it deposits aluminium metal at the cathode electrode. The electrolyte is formed by dissolving alumina in molten cryolite, and in passing through this the current decomposes the alumina into aluminium and oxygen. The oxygen attacks the carbon electrodes forming carbon dioxide and this results in heavy electrode consumption—a serious item in the cost of the process.

The molten aluminium is tapped off at intervals of two or three days, according to the size of the furnace, and is afterwards re-melted in a reverberatory furnace and cast into ingots, slabs or bars as may be required. The average yield of metal is 1 lb. for every 2 lb. of alumina.

Hydro-Electric Power

The electrolytic production of aluminium requires a great deal of current and therefore a cheap and ample source of power must be available. The cheapest source of power is water, and the aluminium industry has concentrated itself in areas where water power is abundant. The British Aluminium Company Ltd., for instance, have extensive aluminium reduction works at Kinlochleven in Scotland, and have carried out hydro-electric developments on a huge scale in order to supply the necessary current. This company produces refined alumina at Larne Harbour, Co. Antrim, Ireland, and at Burntisland, Fifeshire, Scotland, and has also power and reduction plant schemes in Switzerland and Norway.

In the same way throughout the world we find that hydro-electric power is utilised for the production of aluminium.



How to Start an Aquarium.

By W. COLES-FINCH
(Resident Engineer, Chatham etc. Water Co.)

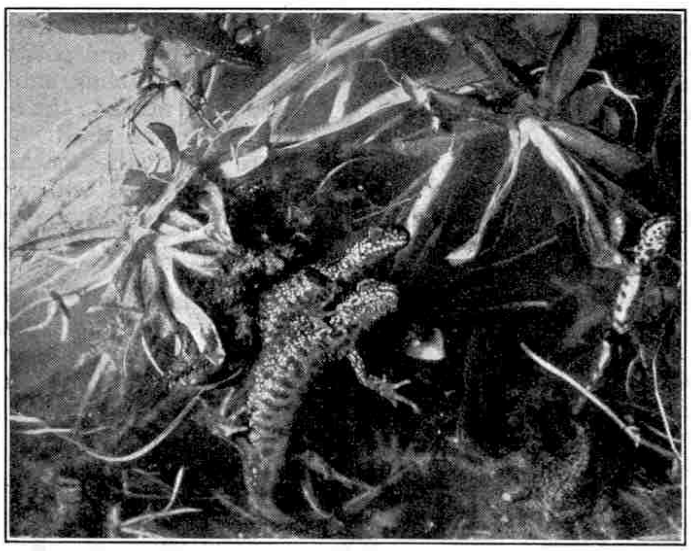
V. POND LIFE—NEWTS

AMONG all the creatures suitable for study in the home aquarium, Newts are general favourites, and they possess the advantage of being able to share the tank with the pugnacious Stickleback.

Every boy knows how to capture a Newt by means of a bent pin, a length of thread, a stick and a garden worm. An alternative is the dexterous use of a hand net when the creature comes to the surface of the water to breathe. This it does periodically and frequently, taking in a mouthful of air with a popping noise and then returning to rest awhile among the water-plants below.

Newt-Tadpoles

Our ponds and ditches generally provide the two common British species of the "*Salamandridæ*" family. These are the Great Warty Newt, *Triton cristatus*, and the Common Smooth Newt, *Triton punctatus*. The former may be readily recognised, for it is larger than the Common Newt, its back is nearly black and its under parts are of dull orange colour, spotted with black. The Common Newt is seldom more than four inches in length and its skin is quite smooth. The male is of light-brownish grey above, spotted irregularly with black. Beneath it is light yellow, changing to brilliant orange, also spotted black, in the breeding season. The female is more soberly coloured and is thus not so attractive a creature as the male.



Great Warty Newt and Common Smooth Newt

At the approach of Winter, Newts leave the water and hide away in little groups in any place offering protection near the margins of the pool, pond or ditch. They sleep through the winter and with the advent of Spring awaken from their long hibernation and return to the water. The male then begins to assume his indented crest which runs down the centre of the back, but the female remains crestless.

In May the female deposits her eggs, selecting for each egg a single leaf of a water plant, preferably the Starwort or Canadian Water-weed. She carefully envelopes the egg in the leaf, drawing the edges of the leaf together and glueing them firmly by means of a sticky substance that exudes from her body. Then she leaves the egg to hatch out. When the tiny creatures appear they wriggle their way out of the imprisoning leaves and commence their wonderful metamorphosis, passing from the tadpole state with its fringed gills to the perfect creature.

Replacing Lost Limbs

It is owing to the Newt's peculiarity of spending only a portion of its existence in the water that these creatures, in common with the Frog and Toad, are classed as *Amphibia*. This word is derived from the Greek *Amphis*, meaning both ways, and signifying a "double life," partly in the water and partly out of it. In early life—the tadpole stage—such creatures breathe by gills or branchiae the air that is dissolved in the water. Afterwards, in the adult stage, they throw off these organs and breathe atmospheric air by direct lung respiration.

As in the case of the lobster and certain other creatures, the Newt can replace its lost limbs. The writer trusts, however, that no boy will test the accuracy of the statement by purposely mutilating his little pets.

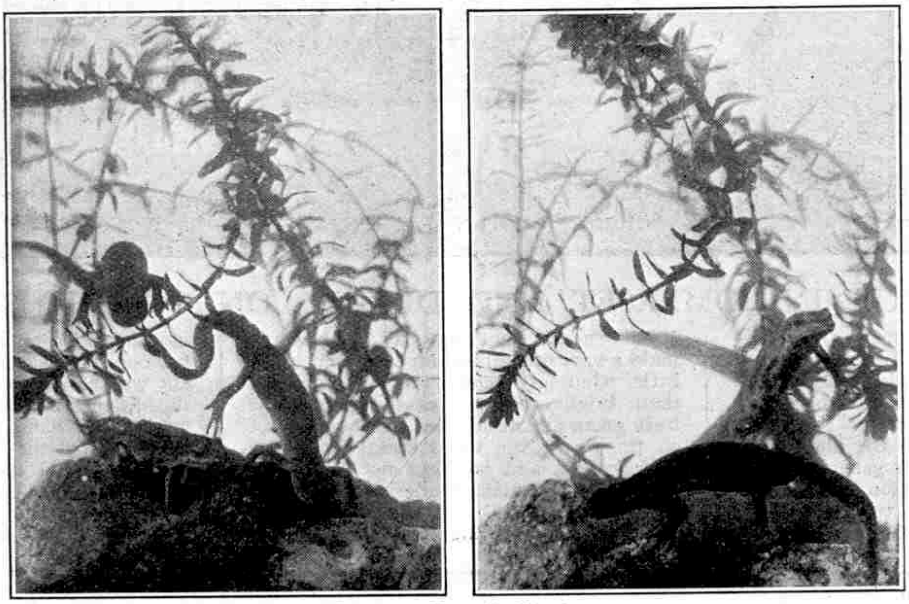
Another interesting feature is the manner in which, from time to time, the Newt first becomes sluggish and then proceeds to shed its skin. The thin filmy skin will be readily seen, and it is an interesting task to float it carefully, by the aid of a camel-hair brush, on to a clean post-card and spread it out, even to the toe-tips, leaving it to dry for further inspection. It will readily adhere to the card and will be found to resemble a thin water-colour drawing of the creature.

Newts are voracious creatures and will devour small newts, tadpoles, worms, and shreds of raw meat.

They will fight over a large worm, each contestant pulling in a different direction until either one annexes the complete morsel or the worm parts in two and each is satisfied!

A Roman Proverb

The amateur photographer will find that Newts provide excellent subjects. They rest in graceful attitudes for considerable periods upon plants or rockery and thus give every opportunity to obtain excellent negatives of them, as if in their native haunts.



Common Smooth Newts

The Newt is also known as the Salamander, and the Romans appear to have regarded this harmless creature with considerable alarm, for they had a proverb: "He who was bitten by a Salamander had need of as many physicians as the reptile bore spots." As a matter of fact the creature is as inoffensive as it is interesting.

A rockery or floating water plants should be provided in order that the Newts may recline thereon out of the water when they so desire, but care should be taken that they do not escape, for they never fail to take an opportunity to do so.

At this stage I would strongly impress upon the reader the fact that the aquarium containing the fishes we have already described must in no way be considered as a receptacle for the creatures dredged and netted in the ponds and ditches. The fishes offer a special delight of their own, not to be confounded with the closer study of pond life, for which purpose the tank is absolutely unsuitable. Of all the pond creatures the Tritons alone should find a temporary place there for just a month or two in the summer, and then should be given their freedom.

Studying Pond Life

The student of pond life should provide a series of ordinary glass and earthenware jars and dishes and furnish them with plant life, if only a spray or two. These should be placed on a shelf in a position where a good light is available, but where they can be screened from the direct rays of the sun, and where they will be readily available for immediate use when returning from a "ditch foray." In this manner the creatures may be watched more readily and much will be learned of their wonderful life.

Before proceeding further with pond life I would remind the reader that if he should contemplate obtaining fishes for his aquarium from a distant agent, this should be done in the approaching cold weather. As was explained last month, fishes prefer cold to heat and therefore at this time of the year they may be sent with practically no loss in transit. On the other hand a journey in hot weather is very trying to the fishes and frequently causes many casualties.

I understand from several correspondents that their fishes have developed the greenish-white fungoid growth on their scales; that is a sign of the presence of a vegetable parasite known as *saprolegnia ferox*. I have read with interest the various unsuccessful attempts that have been made by readers to cure this contagious disease. My advice is to clean out the tank, destroy its contents, and begin again, changing the source from which the stock was obtained. My reason for the last proviso is obvious, for the disease is the outcome of neglect and want of light, coupled with unwholesome water.

Every aquarium keeper should make a point of observing at least once the life cycle of the frog. The spawn of the frog may be easily obtained from pond or ditch early in the year and should be placed in a shallow vessel, the bottom of which is covered with well-washed river sand. Provided they are given sufficient light and heat the eggs soon hatch out into tiny tadpoles, which should be transferred to a tank after they have consumed as much of the spawn as they will eat. The tadpoles should have the tank to themselves and this should be provided with two or three different kinds of water weed.

Small Tortoises

From this point the existence of the tadpoles surely must be thrilling, for in a short time they pass through an astonishing variety of experiences. They grow little legs, their tails are absorbed within the body and disappear, they lose their gills and finally begin to breathe by means of lungs, although they retain an additional power of breathing through the skin. These changes are interesting to watch and they provide an excellent opportunity for the amateur photographer to portray them step by step. The food of the perfect frog consists of minute insects, and as it is almost impossible to provide sufficient of this food the little creatures should be given their liberty.

Those who desire to break away from the beaten track may experiment with the keeping of one or two small fresh-water tortoises. If these creatures are to live peaceably with fishes they must be small. They make interesting pets, and if provided with an island and fed upon small pieces of meat will thrive well. Remember that these creatures are good climbers and therefore their tanks should be kept covered.

(*For Aquarium advertisements see page* 620)

How to Start an Aquarium.

By W. COLES-FINCH
(Resident Engineer, Chatham etc. Water Co.)

THE articles on this subject that appeared last year in our June—August, October and November issues met with widespread approval and in response to a very large number of requests the articles are being resumed this month.

For the benefit of new readers we propose to give a short summary of the chief points dealt with last year, particularly in regard to certain matters that are of vital importance and make all the difference between success and failure. No hobby affords so much interest with so little trouble as aquarium-keeping, but we must be prepared to devote the necessary few moments each day to the welfare of our delicate pets, which otherwise would be faced with a lingering death.

The Tank

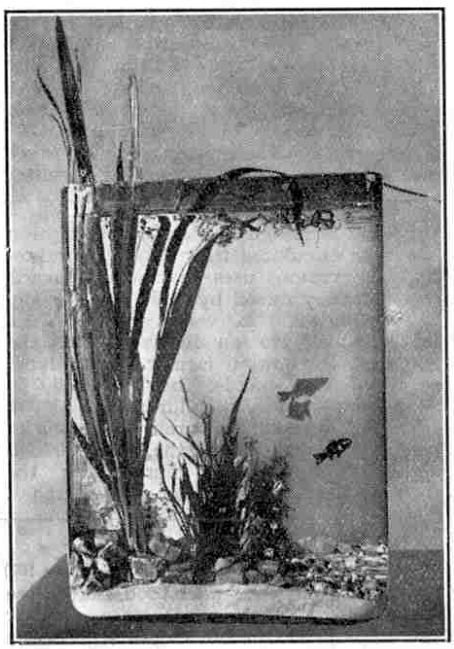
In our second article (July 1925) instructions were given for the building of a very suitable tank guaranteed to give no trouble from leakage, and readers who are anxious to construct their own tanks should refer to this article. Failing this, suitable tanks may be purchased ready-made or even a bell glass may be used. The familiar fish globes should be carefully avoided, however, for they are thoroughly unsatisfactory as regards the health of the occupants and they have the additional drawback that, when the fishes are looked at through the glass of the globe, they appear greatly distorted in shape.

Whether the bell glass or the more satisfactory rectangular tank be adopted, the one important point is that surface area must never be sacrificed to depth of water. The amount of the life-giving oxygen taken up by the water is in proportion to the area of the surface of the water exposed to the atmosphere, from which it will be clear that the fish globes just referred to are utterly unscientific in design.

How Fishes Breathe

The next matter of importance is that we should grasp the secret of how the fishes and plants in our tank breathe and live. The water received by the mouth of the fish is drawn to the gills and expelled through the gill openings. During this process the delicate membrane of the gills takes up some of the oxygen that is dissolved in the water, and thus the fish breathes. It is important to note that it is only dissolved oxygen that is breathed in this manner, and not the oxygen that forms one of the constituents of the water itself.

Having made use of the oxygen inhaled, the fishes exhale or breathe out carbon dioxide just as we ourselves do. This carbon dioxide is the principal food of growing plants which, by the aid of sunlight, break it up and utilise the carbon, along with water and a small quantity of mineral matter, to build



A Snap, sent by a reader, of an aquarium made in the glass container of a large disused accumulator

up their structure, afterwards giving out the oxygen that remains. Thus fishes breathe in oxygen and breathe out carbon dioxide, while the aquatic plants in the aquarium absorb the carbon dioxide and return oxygen to the water. In other words the fishes and plants in an aquarium supply one another's needs, and in order that life in the aquarium may proceed happily on sound lines a balance must be effected between the plant and the animal life.

If the fishes in the tank are too numerous or too large in proportion to the amount of plant life, the oxygen will be consumed more quickly than it is given off by the plants or absorbed from the air, and the water will become exhausted of oxygen.

Signs that Fishes are Suffering

When this condition arises the fishes are driven to seek air at the surface of the water. It is a pitiful sight to watch the little creatures, in desperate need of oxygen, swimming round and round the tank with their mouths at the surface of the water, and it is a sure sign that the fishes are suffering severely. One often sees fishes in this unhappy condition exposed for sale, and they should never be purchased. It is highly probable that, as the outcome of this unnatural form of breathing, they have already contracted inflammation of the gills, and this and other diseases consequent upon life under such unwholesome conditions are extremely likely to cause death to our pets and disappointment to ourselves.

Shading the Tank

In most cases the actual position in which a tank is placed depends to a great extent upon household arrangements, but in every case care should be taken to provide some means of shading the aquarium from direct sunlight during the heat of the day.

Fishes need both shade and seclusion and in their natural surroundings this is provided by trees and plants overhanging the pond or stream in which they live. It is usually a simple matter to provide the necessary amount of shade and by doing so we shall greatly increase the health and happiness of our fishes.

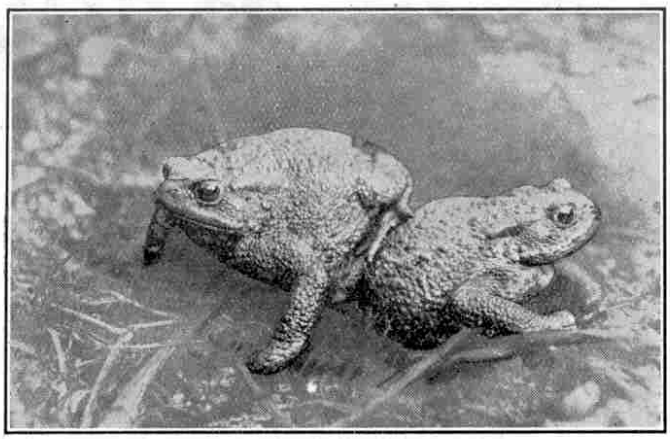
Stocking with Plants

When the tank has been placed in the position that it is to occupy, the bottom should be covered to a depth of 1½ in. with scalded and washed coarse sand or pea-gravel. A local pond or stream should now be visited and suitable water plants collected. Sprays of these plants of convenient size should be washed clear of mud and gathered up into little bunches, each bunch being attached to a piece of broken flower pot which is buried in the sand to act as an anchor to the plant.

Now fill the tank carefully with clear spring, stream or rain water if possible, or failing these, water from the domestic tap. The water should be poured in gently so as not to disturb the plants at the bottom and any cloudiness produced

will settle in a few hours. By means of a thin rod or pencil assist the plants to spread themselves gracefully and naturally in the water. This is the first step in the preparation of a really efficient aquarium and on no account must fishes be introduced at this stage.

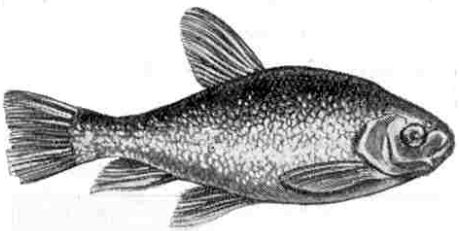
The plants should now be carefully watched and when they show by new growth that they are thriving and when, under the influence of light, silvery beads of oxygen rise from the leaves to the surface of the water, the time has arrived for our second step. Another visit to a pond or stream should be made and the various plants searched for water snails, a considerable number of which should be placed in the tank. These snails will act as the scavengers of our aquarium, for they eat the confervoid growth that forms on the glass as well as decaying portions of the water plant. A few days should now be allowed to elapse and then the time has arrived for introducing the fishes.



Brother Toads

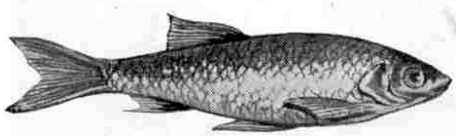
Suitable Fishes

It is at this stage that the beginner frequently makes his first serious error, namely, that of providing too many or too large occupants. The smaller the tank the smaller must be the inmates. Our idea should be that the tank shall represent in miniature a portion of a typical pond or stream with thriving plants and healthy fishes, and not be merely a vessel containing imprisoned fishes. If the fishes are small they have room to dart about, and a larger number of small fishes full of activity will give much greater pleasure than one or two large specimens that have barely room to move.



Tench
(*Tinca vulgaris*)

For a beginner I suggest the hardy Goldfish, until some experience is gained as to management, feeding, aeration of water, etc. I must seriously warn the reader, however, that often these fishes are, by reason of neglect, sick at the time of purchase and suffering from diseases for which there is no cure. Make all your purchases from reliable firms who understand the subject and provide healthy fishes.



Dace
(*Leuciscus vulgaris*)

At a later stage there may be introduced, if the tank admits of it, small specimens of Common Carp, Prussian Carp or Golden Orfe. These, together with a little school of Minnow, will provide a pleasing assortment. Still later, the Carp could give place to Dace, Gudgeon, Chub, Tench or Roach, reserving a separate vessel for the pugnacious Stickleback, which must not be overlooked. All these creatures were dealt with in last year's articles to which readers are referred.

How to Feed

We must now make a short reference to feeding, and it must be emphasised that very little food is actually required. Ants' eggs (kiln-dried), chopped shrimps, shreads of raw meat, hard boiled egg, very small worms or finely broken vermicelli may be given from time to time, but only in such small quantities that all is immediately consumed. If any small particles of food remain they must be removed and not left to foul the water. This is best done by means of a narrow glass tube used as a "pipette." The top end of the tube is closed by pressure of the finger and the other end is lowered into the tank until it is just above the particle to be removed. The finger is then lifted and water rushes up into the tube, carrying with it the offending particle. Once more the top of the tube is closed with the finger and tube and contents are then withdrawn from the tank.

Hot Weather Troubles

However carefully an aquarium may be stocked and managed there are times during spells of hot weather when the fishes show clearly, by swimming to the surface, that they are not obtaining sufficient oxygen in the water.

Immediate steps must be taken to remedy the trouble by revivifying the water in some manner. For this purpose the ordinary garden syringe is very useful. Fill it with water from the tank and discharge the water again into the tank with considerable force, holding the syringe a few inches above the surface in order that the returning water may carry with it the atmospheric air in a stream of bubbles. This should give immediate relief to the fishes, and afterwards about one-third of the water in the tank should be siphoned out and replaced by fresh water. This state of affairs should not arise in winter unless the tank is overstocked.

If the tank is sufficiently large, greater pleasure may be obtained and more fishes kept in healthy condition if town's water is laid on through a jet no larger in diameter than a darning needle, turned downward so that the stream impinges upon the surface of the water. This tiny pressure jet will carry with it a stream of silvery bubbles of air in which the Minnows will gambol in the most delightful manner.

Article V. of this series (November 1925) dealt with pond life as studied in the aquarium and introduced the great Warty Newt, the Common Smooth Newt and the Frog. Next month we intend to introduce our readers to that even more wonderful creature, the Water Spider, of which we shall show unique pictures taken at the expense of much time and trouble and patience. We shall describe the wonderful home it builds under water and how it lives and rears its young under water in a silken chamber filled with air, which it does to escape from birds and other creatures that would prey upon it otherwise.

In Reply

A reader writes:—"Will you please tell me if Portland Cement is bad for fishes? Catching the craze for an aquarium, I made one in the garden and lined it with cement. The fishes, which had been kept in jam jars, all died the day I put them in, though I could discover no reason. Would you try and tell me why?"

The writer of our Aquarium articles replies that the tragedy would be accounted for if the aquarium was filled and the fish put in as soon as the cement had set. He points out that the action of hardening in cement goes on for a long time, and that in the early stages the water would not be fit for fish, unless it were passing through as a stream. When the tank was finished several changes of water, once per day, should have been made for a time, and clean sand and plants then introduced until they assumed a healthy appearance. Then the snails should have been introduced and if these flourished and lived, then, and then only, should the fish have been introduced.

The Westminster Book of Bargains

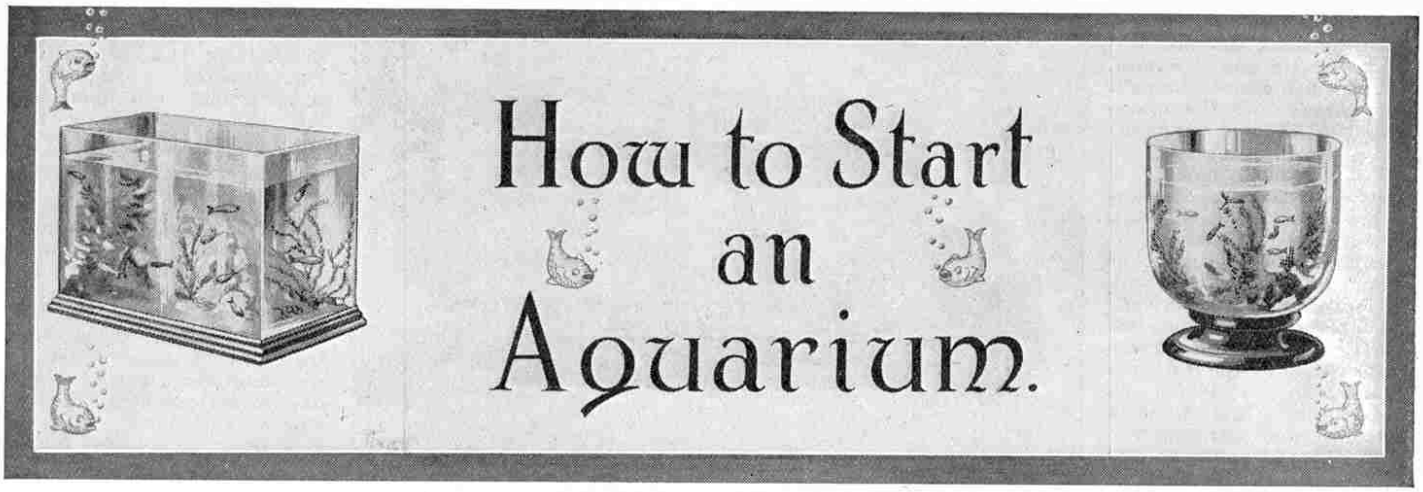
The Westminster Photographic Exchange Ltd. (119, Victoria St., London, S.W.1), a well-known firm dealing in new and second-hand photographic apparatus and material, forward a copy of their latest catalogue, the "Book of Bargains." A glance through the 140 pages convinces us that the title in no way belies the book, for every item is backed by the firm's guarantee. In addition to an extensive list of apparatus for sale, the book contains some very valuable hints to beginners.

Our photographic readers will be well advised to apply for a copy (which will be sent without charge to anyone mentioning the "Meccano Magazine") at the address given above or at their branches 111, Oxford St., W.1, or 62, Piccadilly, W.1.

Gibbons' Stamp Catalogue

We regret owing to a printer's error the title of one of the books reviewed in our December issue was omitted from the foot of the second column on page 663, in some of the copies.

The review referred, of course, to Messrs. Stanley Gibbons' Catalogue "The Stamps of the World."



How to Start an Aquarium.

By W. COLES-FINCH
(Resident Engineer, Chatham etc. Water Co.)

IT is often supposed that the inhabitants of an aquarium consist solely of fish, but this is by no means the case. In addition to the popular types of fishes there are many small creatures that may well be studied and the keeping of which affords considerable interest.

In some cases it is well to keep these small creatures entirely separate from fishes as otherwise they will entirely disappear, serving as food for the other inhabitants of the aquarium. Water fleas, for instance, are very interesting creatures to study, but as they are a delicacy to fish a colony of these interesting creatures soon disappears if kept in the same tank as hungry fish! Often part of the tank may be partitioned off, however, and special partitions may be arranged for separating the fish and keeping them away from the small creatures that form their food. Perhaps an even better plan is to have a separate tank entirely for these tiny creatures, which tank need not necessarily be an elaborate affair.

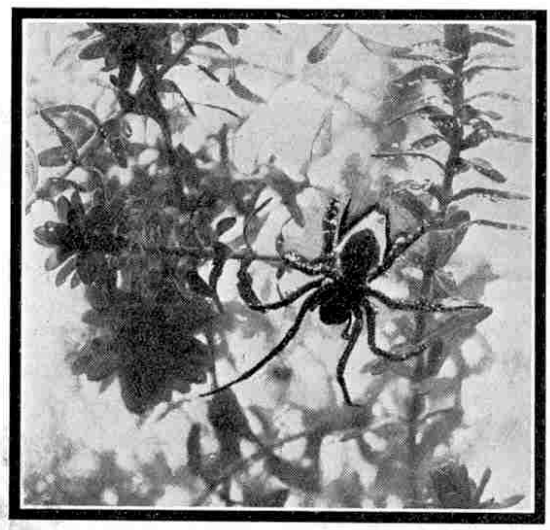
Water Spider looking for a site for her nest

A Remarkable Creature

Among the more interesting of these small inhabitants of an aquarium is the Water Spider (*Argyroneta aquatica*), a wonderful creature. The writer has kept these creatures for many years and found no little delight in photographing them in their aqueous home.

They are sometimes known as "Silver Spiders," from the manner in which their bodies are made to resemble burnished silver by the atmospheric air bubbles that become entangled in the fine hairs.

The Water Spider should have a vessel entirely to itself, prepared as described in previous articles in the matter of plant life, in which it can live without fear or interference by other creatures. Living in these peaceful conditions it will readily construct its beautiful nest, a task that will fascinate anyone with a spark of nature love, and prove the intelligence and ingenuity of the artisan, for it is a dexterous creature.



Water Spider diving with air bubbles. Note beads of oxygen on spider's legs and also on the Canadian water weed

The Water Spider is one of the most remarkable of the inhabitants of our ponds, for though living under water it breathes atmospheric air. In this peculiarity lies all the wonder of the little creature's working, for it constructs its home under water and inflates it and, when necessary, recharges it with atmospheric air, so that this never becomes exhausted.

The Spider's Wonderful "House"

The spiders shown in the accompanying photographs were obtained from Cambridge, but any dealer will obtain specimens to order.

When first installed they took up comfortable quarters under a floating patch of Willow Moss (*Fontinalis antipyretica*) which, as the photographs show was heavily covered with beads of oxygen. There they put in most of their time, merely running a few confused straggling threads leading to the pebbles on the bottom of the tank, these being the preliminaries of the framework of their building.

The *Argyroneta* is a large spider. Its abdomen is olive colour, and the rest, including the legs, is of a dark reddish-brown. Unlike the "Garden" and other spiders, the male is the larger. While the house spider constructs the floor of its web of such fineness that it will support water, the *Argyroneta*

constructs a web under water of such fineness that it will imprison air! Thus the "Diving Water Spider" is rather amphibious than aquatic, although it spends most of its time under water.

Now as to its marvellous house! The spider weaves its silken cell between the branches of some aquatic plant, or anchors it to any object that may suit its purpose. The house is usually entirely submerged, sometimes near the surface, sometimes near the bottom of the tank. It is beautifully transparent and oval in shape, resembling in size half the shell of a pigeon's egg, with the opening or entrance downward in the fashion of the ancient "Diving Bell."

The spider in her nest beneath the water. (Note egg of newt on leaf of water-weed on the left)

Charging the Nest with Air

Before the spider can occupy her transparent chamber comfortably it must be filled with air, and the manner in which this is accomplished is both wonderful and interesting. As the spider rises to the surface of the water, she turns the extremity of the abdomen upwards, and by a sharp snap of the hind legs obtains a bubble of air, which is automatically entangled in the hairy covering of the body. Holding the bubble by the two hind legs, which are crossed at an acute angle near the extremity, she descends quickly and releases the air at the entrance of the chamber.

By repeated efforts of this kind the spider fills the chamber, and by sundry internal smoothings and pressings of the silken dome, to get it into shape, all the water is at last displaced by the air and a chamber having the appearance of a transparent globe of burnished silver is the result. Some 14 journeys are necessary to complete the inflation.

In this subaqueous dwelling *Argyroneta* lives. It is here she devours her prey and lays her eggs, spinning a white silken cocoon at the top of the dome for them. Here her young, about 100 in number, appear in about a fortnight, and remain for a few days.

Almost directly they leave the nest in which they have been born the young begin to construct small homes of web and air for themselves.

It is interesting to note that the male as well as the female constructs such cells, and during the summer no less than the winter.

Feeding the Spiders

Dr. Bateman states :—"In one of these subaqueous homes the *Argyroneta* spends the greater part of the winter. I have had several spiders that have remained in their nests under water for three or four months, without either moving or taking food. When the female wishes to lay her eggs, she either enlarges her old nest or builds an entirely new one. . . . The male spider often makes a new nest for himself near to the one his lady-love has constructed or enlarged for her eggs."

These spiders do not like stagnant water and owing to their sadly depleted numbers they are now difficult to find in many ponds where once they were common. Any reliable dealer will supply them, however.

As regards feeding, the best method is to stock the tank with water-lice and other small creatures from the pond and leave the spiders to fend for themselves. Hunger should be avoided, as when hungry the spiders have decidedly cannibalistic habits!

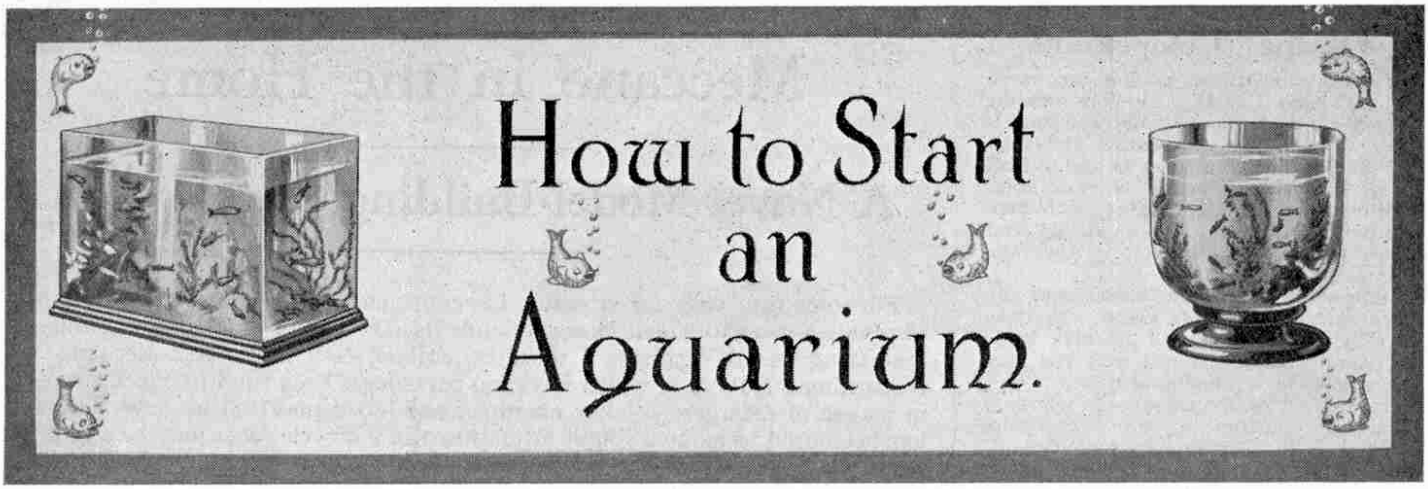
Unfortunately we must pass over many points of interest concerning the *Argyroneta*. A note of the death of my favourite may interest the reader, however, as her picture appears in the accompanying illustrations. Before taking my annual holiday I saw that the tank was in a healthy condition and that the plants were thriving and giving off oxygen freely. The larder was replenished with water-lice, which the spider dearly loves. I foolishly thought that she would take one or two daily to appease her appetite, searching for them among the plants and stones. I was mistaken!

On arriving home I found her resting on a plant in quite a natural way, but she was very thin. I also noticed that the silvery bubble had disappeared from the abdomen, but I still thought that she was merely hungry. I shook the vessel to make her move, when, to my surprise and dismay, her form collapsed and body and legs parted, all falling separately to the bottom of the vessel! I emptied the tank, and search then showed that not a single insect was left. She had probably devoured the whole lot during the first few days, having more than was good for her, and later had starved for want of food.

Spiders are not Insects

I should like to take this opportunity of reminding readers of the "*M.M.*" that spiders are not insects, although they are very often classed as such by those who do not know any better. They belong to the *Arachnida* and are a well defined group of a great branch of the animal kingdom. As a matter of fact, they were at one time classed as insects by Linnæus, but were separated into a distinct class by Lamarck. This class is noteworthy as having an external skeleton, the different parts of which are jointed together in a wonderful manner. They have not a brain in the same sense that the vertebrate animals have, but their nervous system springs from enlargements, or knots, called *ganglia*. It is therefore not incorrect to say that these creatures have a number of brains scattered over their tiny bodies. In this respect they resemble bees and wasps. A wasp will not necessarily die even when cut in two, because its *ganglia*, or "local brains," continue to act for a short time, whereas in vertebrates and in man, death occurs immediately should the head be severed from the body.

Spiders form very interesting pets and may be kept for a long time in confinement if they are fed with flies, or other suitable food. The Water Spider, described above, is not the least interesting of this great family, and perhaps the next in order of popularity is the beautifully-marked Garden Spider, the spinner of those wonderful "cart-wheel" webs that present such a magnificent spectacle in the early morning when covered with dew.



How to Start an Aquarium.

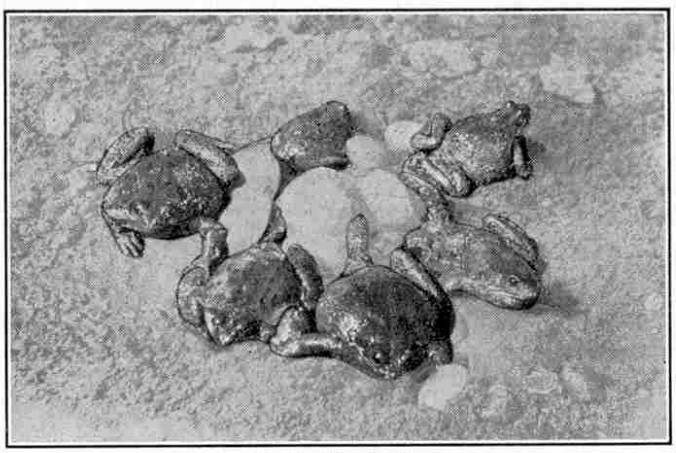
By W. COLES-FINCH
(Resident Engineer, Chatham etc. Water Co.)

POND LIFE: FROGS AND TOADS

IN addition to the inhabitants of our ponds and ditches mentioned in previous articles in this series, quite a host of other creatures offer themselves for our study especially at this time of the year. The life-history of these abounds in interest and wonder, but to describe each one fully is beyond the space at my disposal. I shall, however, be able to refer briefly to many of the creatures more commonly encountered.

The Importance of including Snails

In keeping these lower forms of life, it is better to introduce each group into its own separate receptacle, the top of which should be covered by a piece of perforated zinc or coarse muslin, arranged so as to admit air freely but at the same time to prevent the creatures from escaping. A rockery should be provided, protruding a little way above the surface of the water. If possible it should contain irregular holes or crevices to offer hiding places to such small creatures as may wish to seek cover and seclusion. Pieces of porous rock or clinker may also be placed on the sandy bottom of the tank for a similar purpose.



A Froggy Party

It is important to remember that snails should be included with every group of creatures. As previously stated, they are not only scavengers devouring the confervoid growth that accumulates on the sides of the tank or vessel, but their spawn, which they deposit freely on the water-plants, provides a valuable form of food for the inmates.

Life Story of the Frog

In the little tanks, jars, or shallow pans thus prepared we may place the various creatures that come to our net, also the spawn of the Frog and Toad, the development of which may be watched more readily than in a large aquarium.

The Common Frog (*Rana Temporaria*), sometimes called "the grass frog," is perhaps the most familiar pond creature we have and, as we pointed out briefly in a previous article, is one of the family of *Amphibia*. The spawn of the Frog is a jelly-like mass, differing from that of the Toad, which is formed in a rope-like strand. Eggs of the toad are also smaller and darker than those of frogs. After the eggs have been laid the parents do not take any further interest in them. The spawn may be obtained in the early part of the year from almost any pond.

The spawn when first laid consists of small, dark, globular bodies, surrounded by glutinous envelopes, which absorb water quickly and swell out into soft, transparent coverings. Through these envelopes the development of the embryos may be watched from the time the tiny eggs become elongated to the final appearance—in about a fortnight's time—of the little amphibians.

Where Frogs Go in Winter !

The head is the first to appear. Next, the flat tail is observed, followed by the gills, mouth, nostrils and eyes. Finally the little creature becomes a fully developed tadpole, and if placed under the microscope at this time the circulation of the blood in the gills may be observed.

Later the hind legs appear and then the fore legs, which have been concealed within the gill-chambers. The gills gradually vanish, for the lungs are expanding and the tail grows gradually smaller and finally disappears, the legs meanwhile increasing in size. At length all these wonderful transitions culminate in the perfect little frog, which will hop over the side of the jar, if not too high and seek its fortune in the garden. In winter frogs seek safety and shelter in little family groups near the ponds that they frequent in summer, hiding in any damp muddy recess that offers, there to await the Spring.

Their Wonderful Tongues

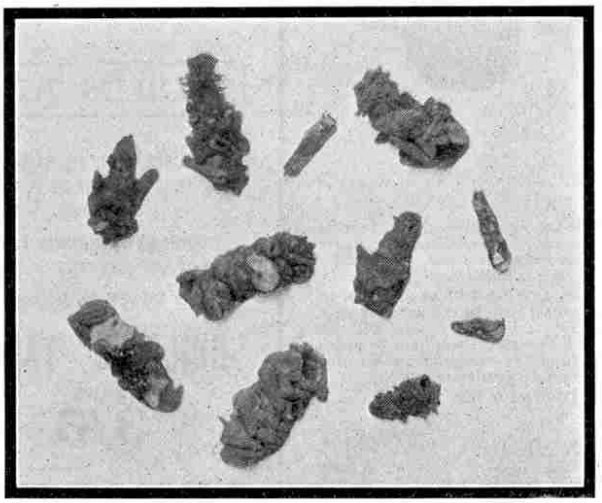
In the tadpole state, frogs feed on vegetable matter, but later on animal food. As tadpoles they devour refuse of all kinds and so make splendid scavengers in the aquarium. If deprived of food, the time of full change is simply delayed and they are kept longer in the tadpole state.

When tadpoles have attained their final development they should be given their freedom, being released in some congenial spot. Although they swim well and quickly, they are by nature land-dwelling creatures and prefer moist situations on land to the open pond.

As already mentioned, they feed on insects, worms and slugs and similar creatures, and do a great amount of good work in keeping insect pests within bounds.

They capture their food by means of their wonderful tongues, which they shoot out with wonderful rapidity. The tongue is remarkable for being fixed in front, and free behind and therefore has a great reach. It has a sticky secretion at the end, enabling its owner to draw every insect it touches into its mouth. Frogs are marvellously accurate "shots" and very dexterous in their search for food. Some time ago it was determined that the frog was able to shoot out its tongue at an insect and draw it back into its mouth in less than 1/200th second! Its cousin the Chameleon is, however, an even more wonderful performer in this connection.

It may perhaps be mentioned that the frog has been used for many years for dissecting purposes in order to enable students to study the outlines of vertebrate anatomy. It furnishes valuable material for many experiments, one of the most interesting of which, perhaps, is that in which a living frog is used as a detector of radio signals!



Photo] [*S.I.B.*

Cases of Caddis

The "Ugly" Toad

When out "prospecting" in some pond, you may land in your net some of the spawn of the Toad (*Bufo vulgaris*), always associated by the superstitious with gruesome things! Although Shakespeare calls it "ugly and venomous," the toad—like the Frog—has a useful mission to perform, in the destruction of grubs, worms, slugs, etc. Also it cannot be too strongly emphasised that toads, like frogs and newts, are perfectly harmless, and in spite of all fables to the contrary they can neither sting nor bite. The toad has suffered greatly from prejudice due to its unprepossessing appearance and it appears to have been always regarded with a certain amount of superstitious fear. The fable of the toad having a jewel in its head, referred to by Shakespeare, may possibly have arisen on account of the brightness of the creature's eyes.

It is quite true that these creatures are capable of exuding unpleasant material from their skin glands, but they are quite incapable of squirting this poisonous substance from their glands as has often been asserted, and it appears to be exuded only under pressure as, for instance, when a dog picks up a toad in its mouth. The experience is sufficiently unpleasant to deter a dog from repeating it!

Toads are nocturnal in their habits, becoming active and emerging from their hiding places at dusk in search of food. During the winter months they hibernate.

Collecting Specimens

When plant life is flourishing in the different receptacles, ponds and ditches may be visited with net and can. An ordinary circular net may be used, and this is easily made by stitching muslin to a bag shape and stitching the neck on to a ring of wire. This is lashed to a strong cane or bamboo, which should be light but strong. If too light it may break under the weight of some great "catch," whilst if too heavy one soon becomes tired having to reach out at arm's length when "fishing" for specimens.

Sometimes it is interesting to use, instead of a net, a glass jam-jar, fastened to a length of light cord. The cord is loosely coiled on the bank of the pond and the jar thrown in to the middle of the pond. Sometimes specimens not found near the edges of the pond may thus be brought ashore.

When using the net, grope carefully with it among the water-weeds, or skim the bottom of the pond, and tip the contents out for examination. Carry a number of small jars, and to these transfer your captures, for taking home. It is also desirable to carry a number of small glass tubes, or bottles with corks, as often minute creatures may be found in the net, the examination of which by microscope or magnifying glass may be of interest.

Collecting specimens is quite an exciting pastime, and next month I shall describe some of the creatures you are likely to capture.

Replies to Queries

GLASS GLOBES.—It is impossible to keep fishes in glass globes without causing them to suffer, and it is cruel to attempt to do so. —(*Reply to G. Watson, Halifax*).

ACCUMULATOR GLASSES.—The glass vessels used for accumulators may be used quite well for keeping fishes. Their main drawback is the inferior quality of the glass as regards transparency. —(*Reply to W. F. Roberts, Swansea*).

ROCKWORK IN TANKS.—Rockwork is extremely useful in a tank of moderate size, but it should imitate nature as far as possible. The imitation castles so frequently seen look absurd in any circumstances.—(*Reply to R. S. Simpson, Chesterfield*).

NUMBER OF FISHES IN TANK.—Your lack of success may be due to several reasons, but it is certain that one of these is overcrowding. You cannot do better than to follow the old and well-tried rule of allowing one gallon of water to every inch of fish. Try the effect of reducing the number of your fishes by half and let us know the result.—(*Reply to W. H. Atkinson, Wigan*).

WATER PLANTS NEED LIGHT.—You are quite right in thinking that your fishes will be healthier and happier because their tank is in a shaded position, but you must not forget that water plants require a considerable amount of light. Try admitting more light to your aquarium, while at the same time shading it from the direct light of the mid-day sun. Provided you have sufficient water plants and one or two pieces of stone or rockwork to provide shelter, your fishes will thrive with considerably more light than you are allowing them at present. After a few experiments you will find it quite easy to balance matters between fishes and plants.—(*Reply to E. Johnston, Morecambe*).

How to Start an Aquarium

Pond Life

by W. Coles-Finch

LAST month we described the apparatus required when you go "pond-hunting," and now we will deal with some of the captures you are most likely to make.

First of all you are certain to find the Water Boatman or Boat Fly (*Notonecta glauca*), so called on account of its being provided with two long oar-like legs by the aid of which it sculls its way rapidly through the water. No more interesting creature can be found. It is rather more than ½ in. in length and its colour is yellow with the exception of a black triangle upon the back.

For its size the Water Boatman is quite a ferocious creature and its beak is able to inflict a distinctly painful wound on the hand. As might be expected, it readily attacks other aquatic creatures and, in an aquarium, unless it is well fed, it will destroy even its own species.

In particular the Water Boatman should never be placed in the same tank as small fishes. The Boatman looks very attractive in the aquarium and is an ideal creature for study, but it will escape if the vessel in which it is placed is left uncovered. Under its wing-cases is concealed a pair of large delicate wings by means of which it makes nocturnal flights, returning to the water at dawn.

If you should come across a flat yellow creature somewhat resembling a dead and faded leaf, you probably have a specimen of the Water Scorpion (*Nepa cinerea*). This creature is very common in most ponds, but it frequently escapes detection on account of its close resemblance in colour to the mud upon which it often rests.

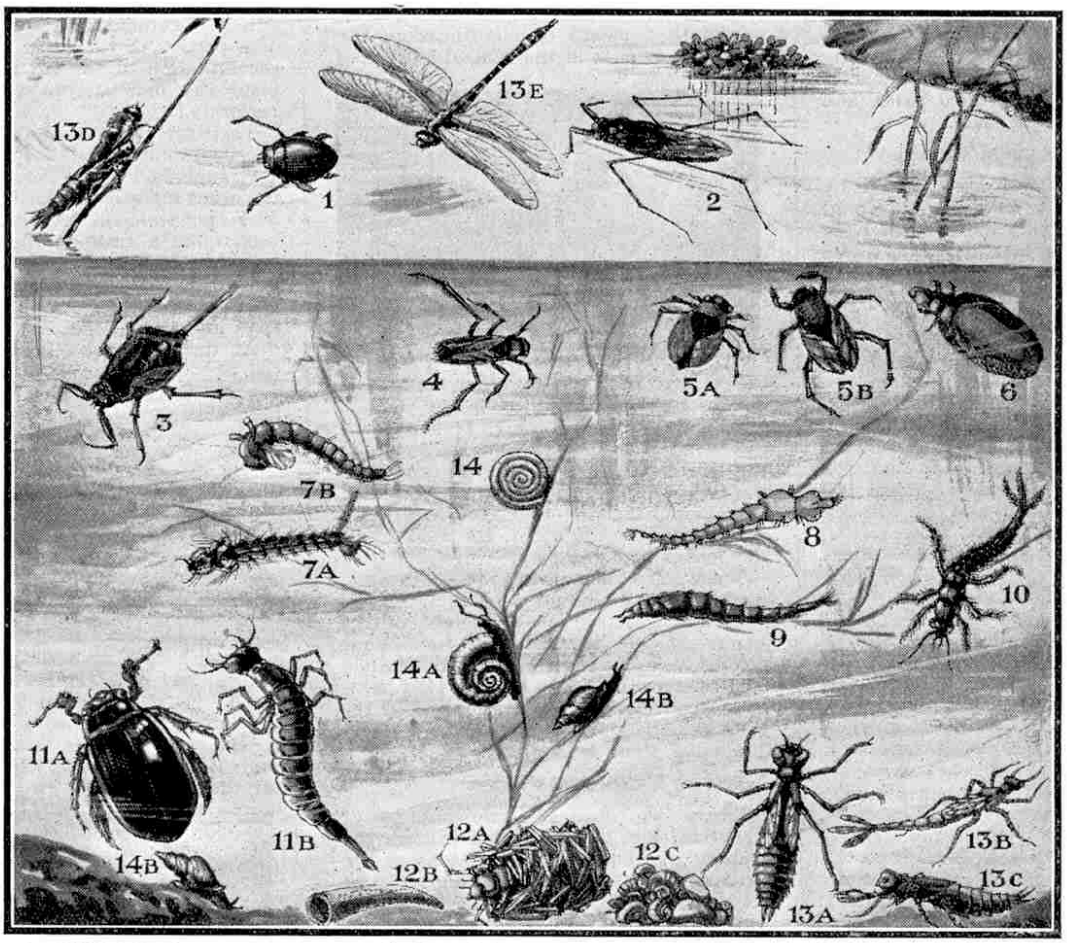
Its appearance is not very attractive, but beneath its sombre outer wings are concealed beautiful opaque, membraneous wings of grey-brown colour. The Water Scorpion will live well in captivity but on account of its aggressive habits it should have a tank all to itself. It will eat almost any animal food and appears to be particularly pleased with a tadpole or small fish.

You may capture also the Whirligig Beetle (*Gyrinus natator*). This creature derives its name from its habit of constantly moving in circles and curves upon the surface of the water. It is about ¼ in. in length and glossy blue-black in colour. It is a good flier, so the tank in which it is kept should be covered. It is not difficult to feed for it welcomes small pieces of raw meat, or water or garden worms.

Many other beetles and small creatures may come into your net and you will find it extremely interesting to watch them and their habits, referring to books for guidance and help in learning their life history.

The Caddis Worm (*Phryganea grandis*), the grub of the Caddis-fly, has a special interest. This quaint creature will be found crawling along the bottom of the pond, safely housed in the tube-like dwelling that protects its delicate and defenceless body from harm. This portable house is constructed by the creature from tiny pieces of plants, shells, sand, etc., and it alone saves him from being devoured by the other inmates of the pond, for his plump soft body is a tempting morsel! The various building materials are fastened together by the help of a sticky secretion that hardens to a kind of silk on exposure to the air, the owner clinging tenaciously to the inside of its house by means of small hooks at the extremity of its body.

The Caddis-worm will complete its house or case in from four to eight hours according to the conditions prevailing, and these may be very trying. Mr. E. C. Ash, in his interesting little book "Pond Life,"* gives the following interesting description of what occurs :—



1. Whirligig Beetle.
2. Pond Skater.
3. Water Scorpion.
4. Water Boatman.
5a, 5b. Water Bug.
6. Water Caterpillar of China Mark.
7a. Larva of Gnat.
7b. Pupa of Gnat.
8. Phantom Larva of Corethra.
9. Larva of Chameleon Fly.
10. Larva of May Fly.
11a. Carnivorous Water Beetle.
11b. Larva of Water Beetle.
12a. Caddis Worm.
12b, 12c. Caddis Worm Cases.
13a, 13b, 13c. Larva of Dragon Flies.
13d. Dragon Fly Emerging.
13e. The Perfect Insect.
14. Planorbis Vortex (Snail).
14a. and 14b. Other Snails useful as aquarium scavengers.

* "The People's Books," T. C. & E. C. Jack

"The building of the case is by no means plain sailing, even should the desired material be in abundance. For each little larva has to reckon with ninety or more brothers and sisters, not including distant relations and perfect strangers, who are equally keen on making a home in the shortest possible time. And so, no sooner has one caddis-worm deftly chosen a suitable object for its personal decoration and started weaving it to the others of its choice, than it is rudely interrupted by a relation or acquaintance.

"Caddis-worms engaged in building fight continually, in a very similar manner as a large number of dogs would over a meagre supply of bones. The owner of a case just started is seized, and during the subsequent struggle loses the result of its labour—the various parts being instantly utilised by its friends and relations; so one can imagine that the completion of a case is no easy matter should the necessary material be scarce."

It is an interesting fact that, whatever material is used, the creature usually manages to make its house of the same specific gravity as the water, so that it has no difficulty in moving about the pond.

When the time of change arrives the worm seeks the shore and abandons its house. The skin then splits and the perfect fly emerges and takes wing.

Provided that sufficient plant life is present, the Caddis-worm will live well in the aquarium and if taken out of its case will promptly proceed to build a new one. It is no use trying to haul it out by the head as this is certain to result in serious injury and the only way is to attack it from the rear with a piece of straw when it will usually leave its home without much argument.

The Dragon-fly is one of the most remarkably beautiful of all pond creatures and it is familiar to even the most casual observer. It has been described as the hawk of the insect world and certainly its rapidity when in search of food is really astounding. The swiftness of its stroke and its unfailing accuracy of aim make it a deadly hunter, and no matter how the victim dodges, the Dragon-fly is equal to the occasion.

The Dragon-fly is frequently spoken of as the "Horse Stinger." The creature certainly has a savage appearance, but it is perfectly harmless and is absolutely incapable of injuring horses or cattle.

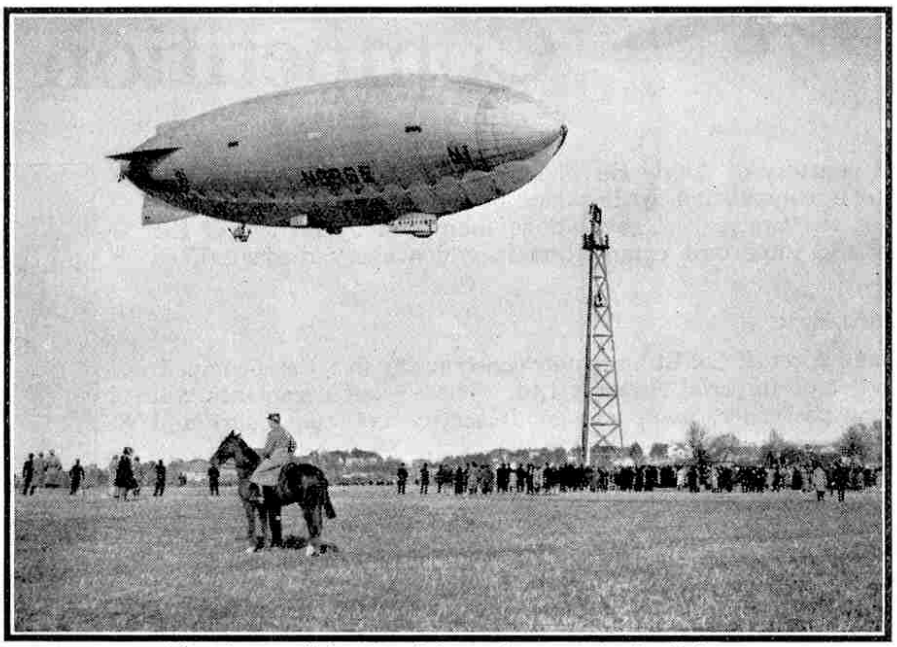
The life-history of the Dragon-fly is one of great fascination and is well worth study. The female deposits her eggs on the water of a quiet pool or on the leaves of some aquatic plant. When the eggs hatch, the larva that emerge are usually dark-brown in colour, thus matching the mud in which they live. They have decidedly healthy appetites and they secure their prey by means of a curious apparatus known as the "mask." This peculiar organ partly covers the lower part of the head and acts as a sort of insect trap. When the larva wishes to seize its prey it suddenly thrusts out the mask, grasps its victim by means of a pair of strong curved hooks or claws, and all is over.

The larva moults several times and finally loses its appetite and climbs some convenient water plant to which it clings tightly by means of its hooks or claws. Presently the old body-covering splits and the perfect Dragon-fly emerges. At first the insect is helpless but as it rests its wings dry and expand, and before long it takes to flight, appearing to revel in its new power of movement.

The larva of Caddis, Dragon and other flies should be kept in a shallow pan or tank of water in which are growing plants that raise their heads above the water, such as Watercress, Forget-me-not, or Crowfoot. Plants of this type are necessary in order that the creatures may climb the stalks above water to complete the final stage of their metamorphosis.

It is regrettable that the Dragon-fly is becoming rarer and indeed certain species seem likely to disappear entirely before very long.

Off to the Pole



The "*Norge*" leaving Oslo on her way to the Pole

Polar Exploration by Air—

(*Continued from page* 356)

A trailing aerial of 300 ft. in length is used both for transmitting and receiving.

"The wireless apparatus is admirable," said Major Scott, who made the trip from Rome to Pulham in the "*Norge*." "We were talking to the British Air Ministry when we were over the Mediterranean, and all the time during the journey over France we were receiving weather reports from the Italian and French authorities. All the wireless messages were by Morse, and not by wireless telephone."

On the night of 13th April the "*Norge*" proceeded to Oslo where she was moored to a mast, as there was no shed there large enough to accommodate her. She was under the command of Colonel Nobile, the designer, and had a crew of 21 men. It is interesting to know that Lieut. Riiser Larsen, who was with Amundsen's 1925 seaplane expedition was second in command.

Immediately the airship was safely moored, the work of refuelling her and refilling the gas bag commenced, and within twelve hours of descending at Oslo the "*Norge*" was once more on her way. The voyage over the Baltic Sea and Esthonia was made without mishap and this 700-mile trip ended satisfactorily when the "*Norge*" landed at the aerodrome prepared at Trotzk, near Leningrad, about eight o'clock in the evening.

The airship remained at Trotzk until word came through that the special aerodrome at Spitzbergen was ready to receive her. The work on this building—which Amundsen declared was the largest timber construction he had ever seen—was temporarily stopped by the severe arctic weather.

At Spitzbergen the "*Norge*" entered upon the most momentous phase of her flight. On the morning of 11th May she was headed for the Pole. Steadily she continued her northward flight without faltering or mishap, and by 2.30 a.m. on the following day she was circling over the Pole.

When it was ascertained on the "*Norge*" that the Pole was actually reached, the engines were slowed down and the airship was brought down to a low level. It was an impressive moment. The crew stood with bared heads while Amundsen, Ellsworth and Nobile each hurled downward to the ice a steel-pointed staff carrying the flag of his country. The rods remained standing with their points embedded in the ice, and as the airship reascended to continue

(*Continued on page* 380)