

would be necessary—at all events safer—to bring the temperature up gradually.

At the Cincinnati Exhibition the temperature was raised from 59° to 70°, a change of 11° in the course of five or six hours, without any noticeable effect, on a lot of brook, Loch Leven, and brown trout.

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**59.—AN INQUIRY AS TO THE PROPER METHODS FOR THE CARE OF LIVING THINGS HELD FOR POPULAR AMUSEMENT AND INSTRUCTION OR FOR PURPOSES OF BIOLOGICAL RESEARCH.**

**By WILLIAM P. SEAL.**

The object of this paper is simply to provoke inquiry as to the proper methods of confinement and treatment of living things—aquatic or terrestrial—whether held simply for popular amusement or for the higher purpose of biological research.

The subject of biological research is one of rapidly-growing importance. Aside from the demands of specialists for facilities for pursuing their investigations, the value of such work in the interest of general education is meeting with wide-spread public recognition, and it is now only a question of time when extensive aquaria and vivaria will become important and necessary adjuncts to the biological laboratory.

In the more practical domain of fish-culture there is a great and as yet untouched field and vast possibilities in the introduction and acclimation of foreign fishes and in experiment leading to the possible transfer of valuable salt-water species to fresh water by gradual change of density, as well as the opportunity for the study of their complete life histories.

Candor compels the acknowledgment that a retrospective review of the scientific results attained through the media of zoological gardens and large aquaria generally, since their first establishment, would show nothing commensurate with the immense outlay involved, and it is a question in the minds of many persons of experience in such matters whether better results are possible. The writer has arrived at the conclusion that nothing better can be expected under existing methods.

As before suggested, the object of this paper is simply to provoke discussion, leading, if possible, to the establishment of other and better methods. The observations of the writer upon animals held in confinement have led him to the conclusion that for purposes of biological research—involving the normal discharge of the natural functions—psychological influences must be taken into consideration as well as those of a purely physical nature, the one having a direct bearing on the other. In other words, animals must be provided with homes adapted to their varied requirements, instead of being held in what can only be termed prison-pens.

In a previous paper\* the writer gave suggestions regarding the establishment of homes for aquatic and amphibious animals, but more especially adapted to those of smaller size. Those suggestions were made on the test of actual experiment. The question arises whether the same methods on a scale of magnitude adapted to the largest animals would not produce equally satisfactory results. Undoubtedly by far the greater cost of maintenance of large aquaria and zoological collections is due to excessive mortality. The laws which apply to the herding or imprisonment of men apply with greater force to the lower animals, which are less amenable to artificial conditions. Fishes confined in small bodies of water are infested with parasites, which do not trouble them in ponds and streams where they have mud, sand, masses of plants and rocks, by means of which they can rid themselves of such pests. Fishes and reptiles, and I doubt not other animals as well, are also undoubtedly subject to diseases analogous to scurvy and others of that nature produced in man by close confinement and consequent impurity of surroundings.

There is another aspect of the case, that of the effects of imprisonment upon the mind. Most persons are familiar with the fact from personal observation that it is almost impossible to confine many of our adult wild birds in cages; as they will refuse to eat and will speedily die of starvation, or will beat themselves to death on the wires of their cages. Those who have had experience in the care of fishes will have noticed the same results in the cases of many kinds of them. It is impossible for an observing person at all experienced in the care of animals of whatever nature not to concede to them the emotions pleasurable or unpleasurable common to mankind regarding surroundings.

Nothing can be more depressing to the lover of nature than the forlorn and dejected appearance of the birds and beasts of fiercer nature as they appear in the limited areas and unnatural surroundings allotted to them in zoological gardens.

Prof. H. C. Chapman states as a result of his examinations of carnivorous animals which have died in captivity, that most of them die of heart disease.

From this benevolent view alone, therefore, this question is one well worthy of consideration. Surely, if the dumb brutes contribute to our pleasure or benefit, we may well afford to consider the possibility of making them measurably contented and happy.

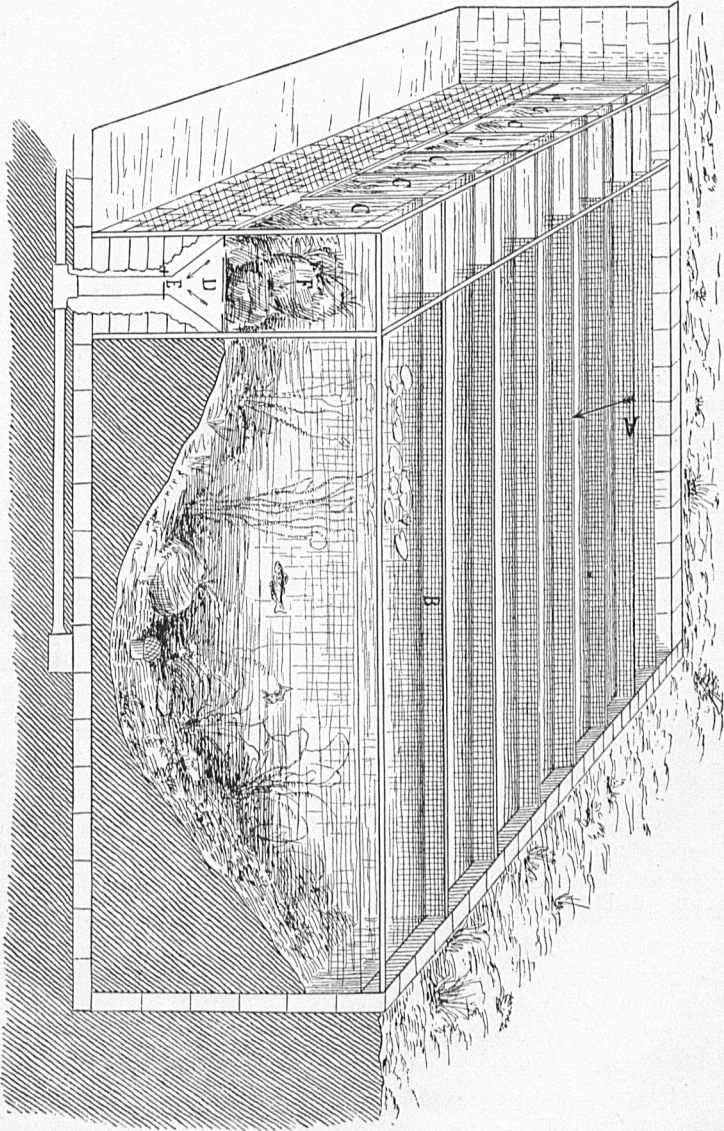
With this idea in view I offer the following suggestion for the consideration of those interested in the establishment of large aquaria, hoping for further development through interchange of ideas.

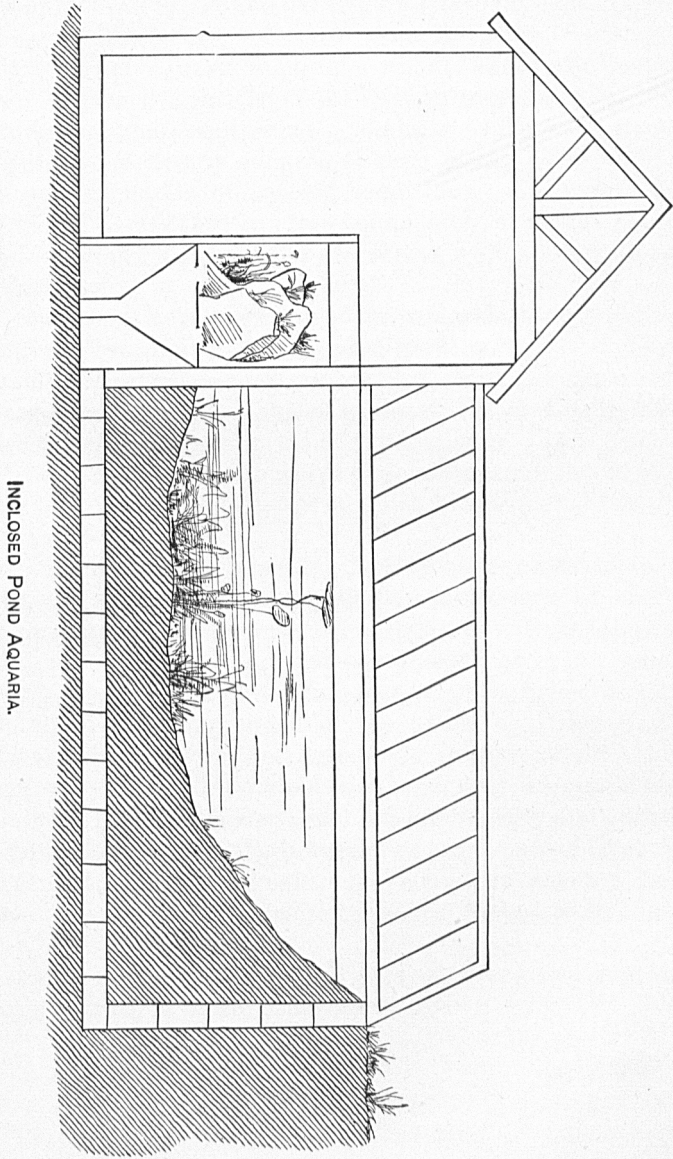
The plan or principle herein suggested might be termed not inaptly Pond-Aquaria, it being essentially a combination of the pond and the

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\* The Aqua-Vivarium as an Aid to Biological Research. Report U. S. Fish Commission, 1883.

POND AQUARIA.





INCLOSED POND AQUARIA.

aquarium; the aquaria being constructed on the margin of the pond or reservoir used, as shown in the accompanying illustration, Plate I; the idea being to have a water-pen or pond-garden (A) extending back from each aquarium front, and to be surrounded by a wire or other fence or partition (B) of sufficiently small mesh to prevent the escape of the occupants, but large enough to allow the smaller fry, which would furnish them with food, to pass through freely. (C) represents the glass fronts. (D) the upper or perforated aquarium bottom, which allows the escape to a lower funnel-shaped bottom (E) of all sedimentary deposits. (F) represents rocky eminences containing pockets, in which could be planted aquatic vegetation at depths adapted to their needs. The whole creating a close approximation of natural conditions. An arrangement of wire gates would keep fishes in close confinement for short periods for observation, or would keep some, while others were allowed to roam at will in their domain.

Plate II represents a cross-section of the same, showing building over the aquaria, and greenhouse roof to pond-gardens.

The advantages of some such plan will, I think, be apparent to all who have experience on the subject at least. It is simply imitating nature more closely and getting rid of artificialities.

The conditions would afford natural vegetation, sunlight, mud, sand, and rocks, with abundance of room in which to move about freely and seek for natural food.

By such a plan also the necessity for circulatory apparatus is dispensed with, the circulation caused by the movements of the fishes, changes of temperature and evaporation, together with the aeration or oxygenation effected by the plant life being ample as in the pond.

It might be argued that, with so large a space, fishes would keep hidden from view. The experience of the writer has been that when the fear of danger is removed and animals become confident of an ability to escape at will when threatened by danger they lose their timidity and become both bold and curious, and are more easily and satisfactorily viewed than when under the influence of fear in close confinement. The deer, the most timid of animals, when confident of safety, becomes perfectly content, and without desire to escape except to seek its kind for company.

The experience of the writer in the care of fishes and reptiles and other animals as well, is to the same effect.