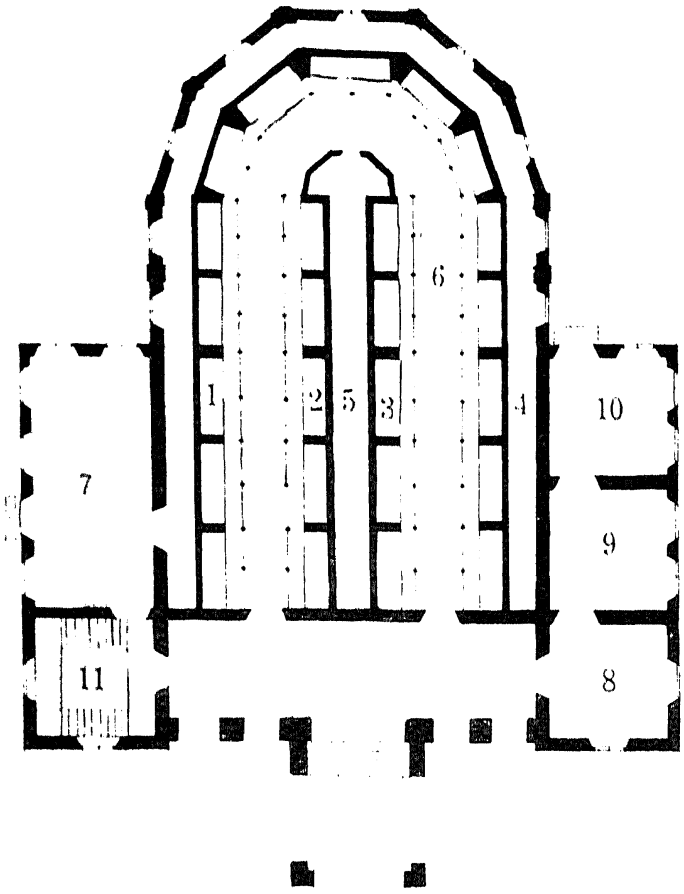
is from a wide verandah 45′ by 18′ and in the centre of the facing wall of this verandah is a large bas relief figure of *Matsyavathar*, symbolising the slow emergence of the higher forms of life from aquatic ancestors, and imparting a somewhat religious atmosphere, which is harmonised by the general architectural design of the whole building.



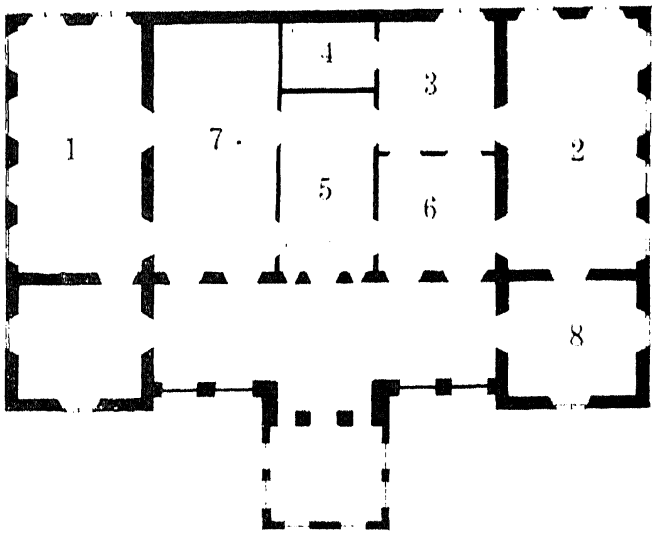
Plan of the Ground Floor

1. Sea water tanks. 2. Fresh water tanks. 3. Brackish water tanks. 4. Service corridor of sea water tanks. 5. Service corridor of Brackish and Fresh water tanks. 6. Visitors' corridor. 7. Curator's office and preparation room. 8 9 & 10. Office of the Department of Fisheries. 11. Staircase room.

The aquarium hall is 75′ by 45′ and takes the form of a crescentic gallery 134′ long with tanks on each side. On the sides there are fifteen sea-water tanks while the central part is occupied by two parallel longitudinal rows, with seven tanks in each row.* Thus there are altogether twenty-nine tanks, of which all excepting six small tanks are meant for the display of rare and interesting forms of aquatic life.

The outer tanks are constructed 3½ feet away from the side walls of the aquarium hall, thus providing a continuous 'service corridor' for the sea-water tanks. A similar 'service corridor' is also provided between the two central rows of tanks, which are meant for fresh-water and brackish-water fishes respectively. This arrangement enables employees of the aquarium to attend to the tanks without causing inconvenience to the visitors.

The side and back walls of the tanks are constructed of reinforced concrete and plastered internally with blue cement mixed with water-proofing material, while the front of the tanks is fitted with 1-inch thick glass plates specially manufactured for the purpose by Messrs. Pilkington Brothers, England. Since variations in temperature during any part of the year are not very considerable, the glass plates have been simply built into the concrete without any precautions against expansions or contractions. The upper edge of each glass plate is held in position by a reinforced concrete beam and from the top of this a wooden screen extends right up to the ceiling. This screen cuts off view of the service corridor from the visitors' gallery and also prevents light from the illuminating sources above the tanks from passing directly into the visitors' gallery. The visitors' gallery is not lighted as a rule, while the tanks are lighted from above from invisible sources. As a result of this arrangement the visitors get a series of brightly illuminated pictures of the under water world, but apart from this scenic effect it also satisfies an essential condition in the proper care of fishes.



Plan of the First Floor

1. Junior laboratory. 2. Senior laboratory. 3. Chemical laboratory. 4. Photographic dark room. 5. Common room. 6. Library. 7. Fisheries industrial museum. 8. Office of the Professor of Marine Biology and Fisheries.

The inner surface of the wooden screens, the walls and ceiling of the aquarium hall are all painted light blue, while the outer surface of the screens, *i.e.*, the surface facing the visitors' gallery is painted with a series of submarine sceneries, depicting rare and

* The last tank in each central row is divided into smaller tanks, not shown in the figure.

interesting varieties of fishes and other marine forms of life in their natural surroundings and colour.

The visitors' gallery is 15 feet wide and is bounded on each side by barrier rails, which have been provided for the safety of the glass plates. The total capacity of the fifteen sea-water tanks is 12,600 gallons while the combined capacity of the brackish and fresh-water tanks is 8,400 gallons. Thus it will be seen that both in regard to size, number of tanks and their total capacity this aquarium is the largest on the mainland of the Asiatic continent.

Circulation of Sea Water

The circulation of sea water is based on the Lloyds system in which the same sea water is always in circulation, thus avoiding the necessity of pumping water from the sea daily.

Sea water is stored in a large underground reservoir 35′ by 25′ by 8′ having a capacity of about 49,000 gallons. By a median vertical partition, this reservoir is divided into two longitudinal halves to facilitate cleaning any one half without interfering with the continuity of circulation. From this main reservoir water comes into a mixing reservoir in which fresh water is added to sea water to compensate for losses by evaporation and to keep the salinity constant. Originally it was planned to connect an evaporimeter above the rows of tanks to determine the quantity of fresh water to be added, but as this was not available, owing to the present international situation, addition of fresh water is effected by calculating the salinity of sea water in the tanks at regular intervals.

From the mixing reservoir a 5-inch cast iron suction pipe, fitted with a foot valve, leads into the pumping set. The housing and impeller of the pump, with which sea water comes into contact, are made of hard phosphor bronze, while the delivery pipe is of cast iron. This delivery pipe discharges into a reinforced concrete overhead reservoir 18′ by 12′ by 8′ with a capacity of about 9,000 gallons. From this reservoir water is led into the aquarium hall through 4-inch asbestos cement pipe, which is tapped at regular intervals above each aquarium tank, with ½-inch lead pipes, screwed to the sides, with brass ferrules. The distal ends of the lead pipes are drawn out into narrow jets. As this arrangement enables water to fall into the exhibition tanks with considerable force drawing a good amount of air bubbles along with it, it ensures efficient aeration of water as long as circulation is maintained. However, as a precautionary measure arrangements have also been made for the supply of air to each tank, from a suitable air compressor.

The overflow water from the exhibition tanks is led through 1-inch lead pipe into a cement conduit, which at its farthest end is connected with a 4-inch asbestos cement pipe, through which it flows into the filter tank. The filter bed is formed of five layers of loosely laid bricks, one layer of road metal, 1 foot thick, a layer of gravel, 1 foot thick, and a layer of sand, 2 feet thick, the sand forming the topmost layer. Through this filter, water percolates from top to bottom and flows directly into the underground reservoir, from where it is drawn again through the mixing reservoir into circulation.

One of the advantages of the filter system is that it reduces the nitrogen contamination to a great extent. The chief impurity of the aquarium water, compared with that of the open sea, lies in the excessive quantity of nitrogen present in various forms and in reduced alkalinity. The excess of nitrogen is referable to dead animals or waste food and excreta of living animals. The first two of these sources of contamination are reduced with care and cleanliness and maintenance of a flow of water sufficient to prevent excessive accumulation of sediment, and by the addition of lime and lactate at regular intervals.

Sea water in the underground reservoir is renewed once in three months or at shorter intervals as need arises. For this purpose a temporary pump is erected on the seashore, and water is conveyed to the underground reservoir through 1,800 feet of 4-inch stoneware pipe specially manufactured by the Travancore Ceramic Factory.

Brackish water necessary for esturine fishes is prepared by mixing up fresh water and sea water in the required proportion. This is stored in an underground reservoir and circulated in the same manner as sea water.

Water for the fresh-water tanks is drawn from a well and the overflow water is allowed to percolate through loose sand back into the well, so as to conserve supply even during dry months.

Laboratory

The research section is accommodated in the first floor of the building, and the general arrangement is shown in Plan 2. It consists of two large biological laboratories,

a chemical laboratory, library, common room, a photographic dark room, fisheries industrial museum and the office of the Professor. The laboratories are provided with twelve bench spaces and adequate fittings for biological work. The chemical laboratory is not fully equipped but as soon as circumstances permit arrangements will be made for providing all the apparatus and chemicals necessary for oceanographical work. The number of books in the library is at present very limited; however, the central library of the University and the museum possess a number of important biological journals which are always available for use in this laboratory.

Though the main purpose of the laboratory is the study of problems having a direct bearing on the commercial fisheries, facilities are also provided for researches of a more general or fundamental nature concerning life in the sea and inland waters. The varied shore line of Travancore, and the numerous backwaters and rivers support an extensive and varied fauna, which affords opportunities for practical study of every aspect of aquatic biology, and the constant supply of these collections makes the laboratory particularly suitable for such research. The laboratory as a whole therefore now offers facilities for all kinds of biological work, and it is hoped that these facilities will be used not only by students of the Travancore University, but also by visiting research workers from other Indian Universities.

[1] See B. K. Das, *Curr. Sci.*, 1940, **9**, 110.

CENTENARIES

Richardson, Richard (1663-1741)

RICHARD RICHARDSON, a British botanist and antiquary, was born at North Bierley 6 September 1663. He studied at Bradford School and at University College, Oxford. In 1671 he entered the Gray's Inn. Later in 1687 he went to Leyden and studied Botany under the celebrated Professor Paul Hermann. When he returned home, he practised medicine but did not take fees, as he had ample means at his command.

His main interest was in botanical travels. His garden was considered the best collection of his days. He is reported to have constructed the second hot-house in England. He also collected a valuable library of botanical and historical books.

He was elected F.R.S. in 1712. He made several contributions to the *Transactions* of the Royal Society.

Richardson is acknowledged as having enlarged the list of British plants by persistent travel and investigations throughout the British Isles. He is also said to have fixed the habitats of several specimens.

Richardson died 21 April, 1741.

Sargeant, Charles Sprague (1841–1927)

CHARLES SPRAGUE SARGEANT, an American arboriculturist, was born in Boston, Mass., 24 April, 1841. After graduating from the Harvard University in 1862 and spending some years in the army, he travelled three years in Europe. When he returned to his native land he occupied himself for a time with the development of his garden. This specialisation led to his appointment in 1872 as the Director of the Botanic Garden of his University and first as professor of horticulture and later, that is, from 1879 as professor of arboriculture in the same University.

In 1873 Sargeant was appointed director of the Arnold Arboretum, which was newly created through an agreement between the Harvard University and the testators of James Arnold, a New-Bedford merchant who had died in 1869. The University set aside 125 acres of land and received from Arnold trustees a little over 100,000 dollars the income from which was to be used for the development and maintenance of a plantation in which practically all of the trees, shrubs and herbaceous plants in the region were to be grown and labelled. Tree knowledge was also to be taught to students.

Sargeant devoted his entire energies to this work and converted the original worn-out farm partly covered with natural plantation of native trees nearly ruined by excessive pasturage into a beautiful park in which 6,500 named species of choice trees and shrubs grow as representatives of 339 genera. An incredible number of hardy plants have been introduced into American and European cultivation through the agency of this Arboretum. To-day it stands foremost in its field.

Synchronously with these foundations for dendrology a library was established which has now grown to 40,000 publications on woody plants—largely at Sargeant's own expense. Sargeant's special field of research was ligneous plant. The fourteen volumes of the *Silva of North America* (1891–1902) with illustrations of every species of tree then known north of Mexico is unequalled in its value. The *Woods of the United States* (1885) and the *Report on the forests of North America* (1884) forming volume 9 of the Tenth Census are his earlier works. Sargeant's full bibliography exceeds 200 items. His very latest publication (1927) fittingly deals with the realised idea of his life: *The greatest garden in America, the Arnold Arboretum.*

Sargeant died 22 March 1927.

S. R. RANGANATHAN.
University Library,
Madras.