XIX.—A REPORT TO THE UNITED STATES CENTENNIAL COMMISSION UPON THE PRINCIPAL AQUARIUMS ABROAD IN 1873.

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[Member of the United States Centennial Commission and agent of the Commission at the Vienna Exhibition, 1873.]

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The importance of having an aquarium connected with our exhibition was brought to our attention at an early date by the communication of Professor Baird, United States Fish Commissioner, who wrote: "I would respectfully call the attention of the commissioners to the propriety of taking steps for establishing an aquarium as part of the exhibition at the coming Centennial. You will observe the great success of these establishments which have been erected at Berlin, Hamburg, Naples, Brighton, London, &c., and the movements looking towards the erection of others at Manchester, Birmingham, &c." [Letter to the Executive Commissioner, November, 1872, Jour. Appendix, p. 88.]

Much attention has been given abroad to the construction of marine aquariums on a large scale in connection with exhibitions. One was added to the Paris Exhibition in 1867, and at Vienna, last year, a new one was opened adjoining the Exhibition on the Prater. At Sydenham, the attractions of the Crystal Palace have been greatly increased by the aquarium constructed by an independent stock company.

Such aquariums are permanently attractive and increase in popular interest from year to year, and it is found that if properly constructed and managed they are financially successful. Indeed their success has been beyond the most sanguine anticipations, and it results that aquariums have been established and projected at several points independently of exhibitions, notably at Brighton, Scarborough, and Liverpool.

When combined, as they advantageously are, with reading rooms, conservatories, promenades, concert halls, and places for refreshment, they become places of popular resort, especially in the evenings, and they exert a most salutary influence upon the mass of the people. Indeed they are real blessings to the large class of persons, in manufacturing cities especially, without attractions at home, who would otherwise spend their evenings at the drinking saloons, at cheap theaters, or in vicious wandering through the streets.

Aquariums are particularly attractive and beneficial to the young, cultivating habits of close observation, acquainting them with various and little-known forms of life, the forms and habits of fishes, and encouraging the study of natural objects generally. They may also be made to contribute largely to pisciculture generally, promoting our knowledge of the art of fish-breeding and stocking of our waters with food-fishes.

The outlay for such undertakings, compared with the results, is moderate, and the expense of maintenance is very small. Within certain limits, modified of course by the conditions of the locality, the population, &c., the largest and most liberally projected succeed best. The annual cash profit ranges from 6 to 30 per cent. on the outlay, and the value of the property and the income are constantly increasing.

Fairmount Park has great natural advantages for the construction of an aquarium, not only of fresh but of sea water, and the favorable opportunity to establish one there in connection with the Exhibition in 1876 should not be lost sight of. It should be independent of the Exhibition in its organization, but might be tributary to its success while deriving great advantages from it.

I was impressed while abroad with the importance of this subject in connection with the work of the Commission, and therefore took some pains to obtain the information presented in the following notes.

My acknowledgments are especially due to Mr. Birch, engineer of the aquarium at Brighton and at Scarborough; to Mr. Theodore L. Witt, engineer of the Vienna Aquarium; and to Mr. G. Fuberi at Berlin.

VIENNA AQUARIUM.

The Vienna Aquarium, located near the Exhibition, was completed during the summer, and added to the attractions of the Prater. It was independent of the Exhibition, being erected by a joint stock company with Baron Albert v. Klein-Wisenberg at its head. A concession of level land was obtained from the court. An ornate building of one high story, about 200 feet long and 100 feet wide, was erected upon a plan founded on the studies made of all existing aquariums by H. Nowak and the engineer Theodore L. Witt. It is constructed of brick and stucco, and is approached by a high flight of steps. All of the exhibition tanks are upon the main floor. The outline plan annexed will

give an idea of the interior arrangement of the tanks and side rooms for alligators, &c. It is drawn to $\frac{1}{750}$ of the actual size.

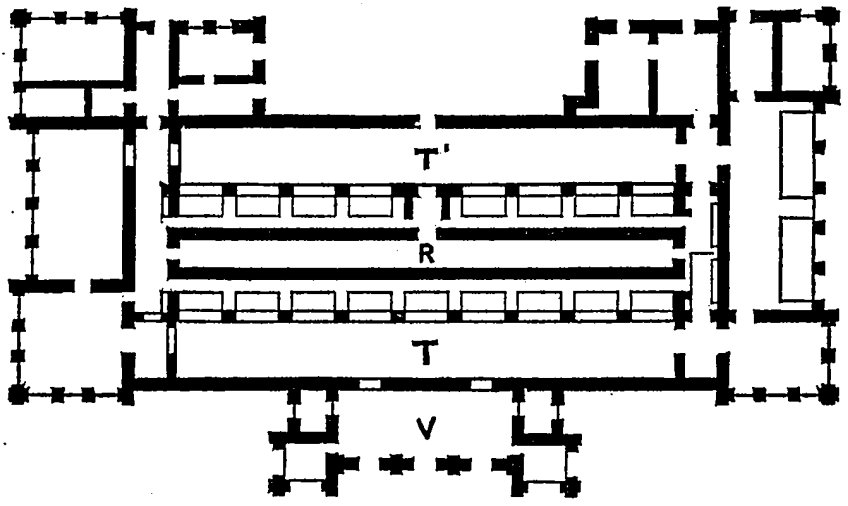

FIG. 1.—GROUND PLAN VIENNA AQUARIUM.

V.—Vestibule or entrance porch paved with tiles.
T. T.—Tanks, in two parallel lines, back to back.
R.—Reservoir between the two lines of tanks.

There are two rows of tanks, eight in each row, placed back to back, with a space between utilized for a reservoir holding a large amount of sea water. Each tank is about 9 feet long by 4 feet high and 5 feet in depth backward through the plate-glass front to the rock work. Each contains when half filled about 100 cubic feet of water. These tanks are made of brick and cement, open at the top, and accessible in the rear by a passage-way on each side of the central space R in the plan. The plate-glass fronts are $1\frac{1}{2}$ inches thick. The rooms at each end are used for large shallow basins for crocodiles, fresh-water fishes, and a collection of sea anemones.

The marine fish are brought up from Trieste, and the salt water also, by rail over the Semmering Pass. Some salt water has been successfully made. The circulation of the water is maintained by pumps driven by a small steam-engine, and the aeration is effected by a slender jet of water which, escaping under pressure, impinges on the surface and carries down a large amount of air into the body of the water. Another plan is to force air in fine jets from below and let it ascend through the water. Sixteen cubic meters of salt water and alike quantity of fresh water are renewed hourly. A resident zoologist has been engaged to take charge of the scientific part of the enterprise. It promises to be a pecuniary success, notwithstanding a great outlay for the building and fixtures, amounting to 250,000 florins, or about $125,000. The daily receipts amounted to about $350 for some weeks. The expense of

maintenance will be very slight, probably not over $8,000 or $10,000 annually. A naturalist is employed at Trieste in securing and forwarding specimens.

The entrance price was fixed at 50 kreutzers for adults and 20 kreutzers for children.

CRYSTAL PALACE AQUARIUM.

The aquarium is one of the added attractions to the permanent exhibition at the Crystal Palace at Sydenham, and being the property of a separate company an extra price is charged for admission. It has been very popular and is reputed to have paid 30 per cent. upon its cost annually. There are eighteen large show tanks and two rooms fitted with smaller basins or reservoirs. It is intended that the collection shall embrace the whole series of marine fauna. The cuttle fishes, the cray-fish, and the octopus attract special attention. It is located at the north end of the Palace, between the tropical department and the north rater-tower. It is below the main floor level, and is reached by a flight of steps.

THE AQUARIUM AT BRIGHTON.

This great attraction to the citizens of London and the United Kingdom and to the traveling public owes its existence to private enterprise under a joint-stock organization. It is located at the sea-side, upon land which may be said to have been reclaimed from the sea close to the chain pier immediately below the cliff, the building being protected from the waves by a strong sea-wall formed of concrete and Portland stone. It was provisionally opened at Easter, 1872, but not to the public until the following August, upon the occasion of the visit of the British Association.

The building is 715 feet in length, with an average breadth of 100 feet, and is sunk below the surface for the most part in order not to intercept the view of the water from the cliff and the line of buildings facing the beach. It was erected from the designs and under the superintendence of Mr. E. Birch. It is on the Italian style of architecture, and bricks, terra-cotta, granite, and tiles are the chief materials. Mr. Birch visited the Boulogne aquarium in 1866 and wasled to conclude that the construction of marine aquariums on a scale of magnitude hitherto unattempted was a matter eminently fitted for British enterprise. Brighton, being a place of great resort on the coast and readily accessible from London, was selected as the most feasible spot for the construction.

On entering, the visitor finds himself at the head of a broad flight of granite steps, with tiled platforms at intervals, so that the descent is rendered very gradual and easy. There are five arched portals 18 feet high, supported by decorated terra-cotta columns. On one side is the restaurant, and on the other the reading room, where the serials and daily papers can be found. For the relative positions of these rooms

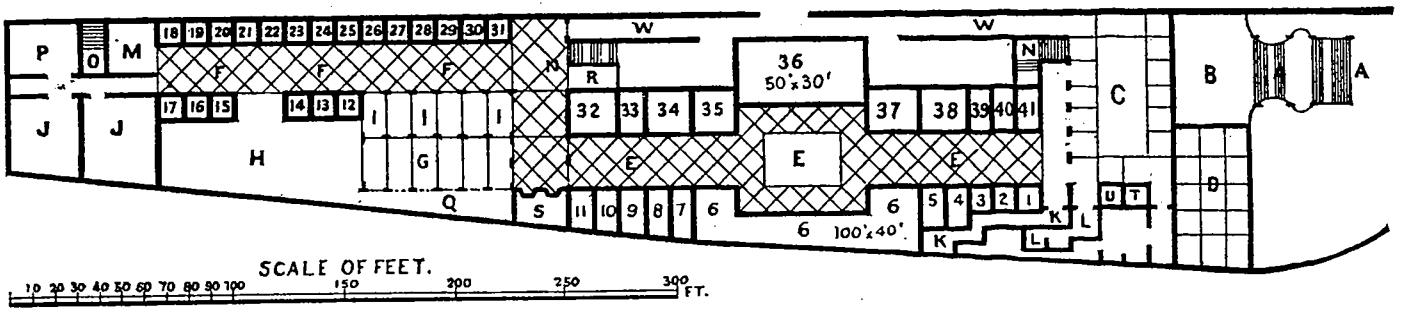

FIG. 2.—GROUND PLAN OF THE BRIGHTON AQUARIUM.

A.—Steps descending from west end (20′ wide).
B.—Entrance court (60′ × 40′).
C.—Entrance hall and reading room (80′ × 45′).
D.—Restaurant and dining hall.
EEE.—Western corridor with tanks on each side.
FFF.—Eastern corridor.
G.—Conservatory.
H.—Rock-work, fernery, and cascade.
III.—Space with table tanks.
JJ.—Engine-room, stories, &c.
KK.—Lavatories.
LL.—Lavatories.
M.—Naturalists' rooms.
N.—Steps from corridors to promenade over
O.—Business and private entrance.
P.—Curator's office.
Q.—Rock-work with ponds for seal, &c.
R.—Grotto.
S.—Heating apparatus.
T.—Clerk's office.
U.—Board room.
W.—Inclines for hand chairs.

and the other parts of the building, reference may be made to the annexed plan, with scale and some of the dimensions stated. Nos. 1 to 41 indicate the tanks.

The retiring rooms and kitchen lie to the north of the hall. The longest of the three corridors extends 220 feet and is broken by a vestibule 55 by 45 feet.

The roof is groined and constructed of variegated bricks. It rests upon columns of Bath stone, polished serpentine, and Aberdeen granite. There are 21 tanks in the first two series. They increase in size from 11 by 10 feet upward, the largest measuring over 100 feet long by 40 feet wide and holding 110,000 gallons of sea water. This is the largest tank in the building and is reserved for such large marine specimens as porpoises, congers, turtles, &c. The next largest tank is 50 feet by 30 feet. The whole of the tanks, 41 in number, are numbered consecutively, commencing on one side. The glass plates for these tanks are of necessity very strong and heavy, being not less than one inch in thickness.

The salt water is taken directly from the sea by pumping and is run into reservoirs under the floors of the corridors, from which it is again pumped by the same steam-engine, and delivered to the tanks as required. The reservoirs hold 500,000 gallons of water. In the tanks the water is constantly aerated and kept in circulation by a stream of compressed air supplied to the lower part of the tanks. It is forced in by the steam-engine. This system allows the water in each tank to be heated separately, and is found in many respects preferable to the method of obtaining circulation by means of pumping. It permits circulating reservoirs to be dispensed with. The temperature of the water is kept down and the impurities are oxidized by the air.

The second corridor is about 160 feet long. One side of the eastern portion is assigned to the fresh-water animals. The offices for the curator and naturalist are beyond. These are fitted up with open tanks and every convenience for the nursing and care of the fish which require treatment before being placed in the large tanks.

The conservatory and fernery are two great additional attractions to the establishment. They are approached from the western corridor. The rock work is here remarkably well executed in imitation of ledges of red sandstone. It is all formed of chalk and cement colored red, and is so well done that few persons would for a moment question its being a natural outcrop. Ferns grow in the clefts, and on projecting tables of the rock. There is also a stream of water, broken at intervals by cascades and ponds, utilized for the seals and the larger reptilia.

In addition to the large tanks, there are numerous smaller or table tanks for the reception of some of the smaller and more rare marine animals. There is also an exhibition of the apparatus for hatching and developing trout and salmon.

The nature of the exhibition, its extent and variety, are shown by the annexed list of the tanks and contents as they were in 1873:

1. Corals, sea-anemones, sea-cucumbers, tube worms.
2. Weevers, smelts.
3. Scad or horse mackerel, young salmon.
4. Black bream, prawns.
5. Mackerel.
6. Turtles, tope, nursehound, sting ray.
7. Skate, spotted ray.
8. Silver whiting, anemones.
9. Codling.
10. Bass, seacray fish.
11. Mackerel, zoöphytes.

Here intersects the conservatory with ponds for the alligators, seals, and table tanks for the smaller animals, such as anemones, corals, serpulæ, young dog-fish, tortoises, &c.

12. Perch, pope, and English pearl mussel.
13, 14. Pike, carp, tench.
15. Gudgeon, minnows, gold and silver carp.
16. Trout.
17, 18. Prussian carp and gold and silver carp, and eels.
19. Sea-horses.
20. Sun-mullet, gray mullet.
21. Halibut, brill, turbot, soles, plaice, flounders.
22. Wrasse.
23. Codling and silver whiting.
24. Eggs of dog-fish, skate, and cuttle-fish.
25. Octopus.
26. Sea-cray fish.
27. Crabs, goose barnacles.
28. Lobsters.
29. Octopus.
30. Sea bream.
31. Anemones, small star-fishes, zooplytes, whiting pout.

Here intersects the Grotto containing gold and silver carp, water lillies, and ferns.

32. Herrings, anemones, sand eels.
33. Stickle-backs, anemones, &c.
34. Conger eels.
35. Cod.
36. Picked and spotted dog-fish.
37. Rock whiting or whiting pout.
38. Spotted dog-fish, nurse, and rough-hounds.
39. Monk-fish and gray mullet.
40. Smooth hounds, sting rays.
41. Gurnard, pipe-fish, dragonets, ascidians.

This great aquarium has been a success in every way. As a paying investment it has been remarkable. The total expenditure was £80,000, about $400,000, which included cost of the land and of the sea-wall and a carriage drive and promenade. Over £25,000 have been returned in dividends. Ten per cent. was paid in 1873 and another dividend of 15 per cent. was about to be declared.

The company publishes a guide-book to the aquarium, giving all needful information to the visitor, and interesting descriptions of most of the fishes. Two distinguished naturalists, Frank Buckland and Henry Lee, are employed. I am indebted to the guide-book and to the engineeer, Mr. Birch, No 7 Wesminster Chambers, London, for the information here given beyond what could be obtained by personal examination.

SCARBOROUGH AQUARIUM.

The great success of the Brighton undertaking has induced the same parties who now hold that stock to project another aquarium upon even a greater scale at Scarborough. The work is under the direction of the same engineer, Mr. E. Birch, who showed me some of the plans. The new work will have some improvements, and will be the finest in existence. Money will be freely used for its advancement and to render it a most attractive place of resort for amusement and instruction. It is confidently expected that it will be a profitable enterprise.

AQUARIUM AT LIVERPOOL.

A new aquarium is not only to be built at Scarborough, but the city of Liverpool is also to have one on a large scale combined with a concert hall, a conservatory, a restaurant, &c. All these portions of the structure will be so arranged as to be in one unbroken line and to give a delightful promenade and place of resort. The general plan is a parallelogram, and there are to be twenty-four tanks, ranging from 6 to 70 feet in length, with a capacity of 100,000 gallons of sea-water drawn from a reservoir capable of holding four times the amount. And in the same manner as at Brighton there will be numerous table tanks and basins. Artificial rock-work ferneries, &c., constitute part of the plan, which is to be executed in the best and most liberal manner. The estimated cost is $250,000, which is to be raised by the sale of shares.

BERLIN AQUARIUM.

The aquarium at Berlin, owned by a joint stock company, founded in 1867 and opened on the 11th of May, 1869, has since been in continuous and successful operation. It is located in the heart of the city, upon the famous avenue *Unter den Linden*, so that it is not only readily reached, but is a constant attraction day and evening to those who have an hour or two at command. It occupies a building in the rear of that fronting on the street, so that the street frontage is not injured for busi-

ness purposes, the entrance being at the side and up a broad staircase through to the rear. The area occupied is 100 square rods and the structure is two stories high, but is so arranged that the distance from top to bottom appears much greater, and indeed all appearance of a building is lost, the visitor being apparently in an extensive natural grotto or cavern, with long vistas underground varied with lakes and little brooks. The semblance of natural walls of rocks and of arches worn out by the elements is admirable. The foot-paths wind about between the tanks for the fish, and are so arranged as to pass one below another and give the effect of distance. All trace of the busy city life without is lost. The sounds of traffic do not penetrate the rocky walls and there is nothing to divert the mind from the study of the habits of the wonders of marine and terrestrial life there brought together.

It has been found desirable to add some of the more remarkable and curious animals and a collection of birds to the collections of marine and fresh-water life, but these animals consist almost exclusively of such species as are seldom found in zoological gardens. The upper story or upper portion of the grotto is devoted mainly to such animals, to birds and reptiles, while the lower portions contain the fish in a series of tanks, with plate-glass fronts bordered by rock-work. The principal divisions of the interior are, the hall of serpents, the geological cavern, the aviary, the fresh-water gallery, the staircase cavern, the northern, the middle, and the southern halls.

In the hall of serpents a variety of the reptiles of Europe and other countries are displayed in suitable wall cages, among them the boas, poisonous serpents, lizards, and chameleons.

The aviary is so arranged as to appear to be in a cavern, the geological cavern, in which the stratification and other phenomena of rocks are shown. There are also basins for crocodiles and other animals. In the fresh-water gallery on the right are placed cages for birds and on the left tanks for the river and sea fishes of Europe. Apparatus for artificial fish breeding is shown along the staircase or winding descent in the cavern, and there is also a small pond for beavers at the bottom. The three large halls are devoted to the marine life. The total number of tanks and cages is not less than 150.

The number of animals, including fishes, &c., is about 15,000, of 800 species, but the number is increasing constantly, and there is more or ess fatality and constant change.

The sea-water is artificially prepared and proves to be satisfactory. About 10,000 cubic feet are required and only such portions are renewed as are spoiled or lost in the basins. It circulates constantly, and is pumped into a reservoir at an elevation of 70 feet, from which it flows to the tanks and is cleared by filtration on the way. Experience entailed successive modifications until satisfactory results were attained.

The place is very popular. It is lighted with gas and is open in the evenings. There are suitable places for resting and refreshments. The

price of entrance is equal to about 25 cents, children half-price, and there are some cheap or half-price days. The total number of visitors from May to December, 1869, was 212,540; in 1870 there were 210,056; in 1871, 215,828, and in 1872, 254,078.

The company is organized with a capital of 200,000 Prussian thalers, equivalent to about $150,000, and regular 6 per cent. dividends have been paid annually. It is understood that there is a surplus fund, and an extra dividend is expected in April, 1874.

The designs for the caverns and rock-work were executed by Mr. Leier, of Hanover, now deceased.

AQUARIUM AT THE PARIS EXPOSITION, 1867.

The aquarium at the Paris Exposition in 1867, was one of the most notable of the attractions of the garden. There was no outer display of a building, nothing but a picturesque addition to the ground in the form of the entrance to a cavern, or grotto. The semblance of a stalactitic cave was perfect. The visitor leaving the green sward and parterres of flowers without, wandered between huge stalactites, in irregular winding passages, shutting out the light of day except that which penetrated dimly through the tanks of sea-water at the sides and in the roof.

THE NAPLES AQUARIUM.

The marine aquarium recently completed at Naples is located on the Riviera, near the central point of attraction to the public. The tanks are arranged on three sides of a large oblong hall, and the light enters the water from above, as in other aquaria. A double row of smaller tanks extend along the center, and these are lighted by a central opening, or court.

The space in the building above is devoted to the naturalists' laboratory, where there are tanks and work tables sufficient to accommodate twelve zoologists. Tables are rented to representatives from the leading universities and museums of the world. Great pains have been taken to secure a full zoological library. It now includes a nearly complete set of embryological works and all the principal zoological journals. These data regarding the aquarium at Naples are condensed from correspondence of the London Athenæum.

MILL ROCK, NEW HAVEN, *May*, 1874.