SENATE No. 700

The Commonwealth of Massachusetts

REPORT

SUBMITTED BY THE

LEGISLATIVE RESEARCH COUNCIL

RELATIVE TO

AN MDC SEA AQUARIUM FOR SOUTH BOSTON

JANUARY 30, 1963

The Commonwealth of Massachusetts

ORDER AUTHORIZING STUDY

(Unnumbered House Order)

Ordered, That the Legislative Research Council be directed to investigate and study the subject matter of current House document numbered 2284, relative to providing for the construction and maintenance by the Metropolitan District Commission of a sea aquarium in the Castle Island section of the city of Boston, and to file the results of its statistical research and fact-finding with the Clerk of the House of Representatives from time to time but not later than the last Wednesday of January, nineteen hundred and sixty-three.

Adopted
By the House, July 9, 1962
By the Senate, in concurrence, July 10, 1962

CONTENTS

TABLES

The Commonwealth of Massachusetts

LETTER OF TRANSMITTAL TO THE SENATE AND HOUSE OF REPRESENTATIVES

To the Honorable Senate and House of Representatives:

GENTLEMEN: — The Legislative Research Council submits herewith a report prepared by the Legislative Research Bureau, on an unnumbered House Order directing the study of the subject matter of House, No. 2284 of 1962, relative to providing for the construction and maintenance by the Metropolitan District Commission of a sea aquarium in the Castle Island section of the City of Boston.

The Legislative Research Bureau is limited by statute to "statistical research and fact finding." This report therefore contains factual material only, without recommendation or legislative proposals. It does not necessarily reflect the opinions of the undersigned members of the Council.

Respectfully submitted,

MEMBERS OF THE LEGISLATIVE RESEARCH COUNCIL

SEN. JOHN E. POWERS of Suffolk,
Chairman.
REP. JOHN T. TYNAN of Boston,
Vice Chairman
SEN. NEWLAND H. HOLMES
of Norfolk and Plymouth
REP. STEPHEN T. CHMURA of Holyoke
REP. JAMES F. CONDON of Boston
REP. SIDNEY Q. CURTISS of Sheffield
REP. WALLACE B. CRAWFORD of Pittsfield
REP. HAROLD L. DOWER of Athol

The Commonwealth of Massachusetts

LETTER OF TRANSMITTAL TO THE LEGISLATIVE RESEARCH COUNCIL

To the Members of the Legislative Research Council:

GENTLEMEN:—A House unnumbered order directed the Legislative Research Council to make a study of the subject matter of House No. 2284 of 1962, relative to providing for the construction and maintenance by the Metropolitan District Commission of a sea aquarium in the Castle Island section of Boston.

The Legislative Research Bureau submits such a report herewith. Its scope and content are determined by statutory provisions which limit Bureau output to factual reports without recommendations.

The preparation of this report was the primary responsibility of Francis E. Sweeney of the Bureau staff.

Respectfully submitted,

HERMAN C. LOEFFLER,
Director, Legislative Research Bureau.

The Commonwealth of Massachusetts

AN MDC SEA AQUARIUM FOR SOUTH BOSTON

SUMMARY OF REPORT

Under the terms of an unnumbered legislative order, this report deals with House Bill No. 2284 of 1962. That proposal, introduced by Rep. John T. Tynan of Boston, specified the construction and maintenance of a sea aquarium in the Castle Island section of the City of Boston at a cost of not more than $3 million. The aquarium would be constructed and maintained by the Metropolitan District Commission, and annual costs would be levied on Park District members on the basis of the usual statutory formula. As required by law, the report contains no recommendations.

This proposal is the latest in a series of almost identical proposals by Rep. Tynan in recent years. All of them have been victims of legislative resistance.

FORMER BOSTON AQUARIUM

The proposed aquarium would replace one which for almost half a century had been located in South Boston and which had attained national prominence. It closed in 1954 because of a lack of suitable exhibits, and the reluctance of the City of Boston to provide badly needed rehabilitation at an estimated cost of $300,000.

When the South Boston Aquarium opened its doors in 1912 it attracted tremendous throngs, and continued to be a popular attraction for many years with about 300,000 visitors annually. No admission fee was ever charged.

HISTORICAL BACKGROUND

Public aquariums date back for more than a century The first was located at Regents Park, London. Built in 1853 it consisted primarily of a meager series of standing tanks in a conservatory building.

Boston has an historic claim in this field. The second known public aquarium was opened in the city in 1862 at the corner of

Washington and Court streets. It was known as "Aquarial Gardens" and was operated for a few years by the noted entrepreneur of the era, the late P. T. Barnum.

Woods Hole on Cape Cod became a mecca for aquarists in 1883 when the U. S. Commission of Fish and Fisheries opened an aquarium and marine biological laboratory at that location for the investigation of commercial fishing in New England waters.

Since those early days, aquariums have become increasingly popular until today there are more than 216 of them operating throughout the world. Most other important cities have such facilities in operation for the benefit of the public, including New York, Chicago, Detroit, San Francisco and other large cities of America.

MUCH PUBLIC INTEREST

This expanding record reflects keen public interest in local aquariums. Among the testimony of various renowned aquarists on this score, the late director of the New York Aquarium felt that "no other form of public museum is of greater interest to the people. The plentifully stored aquarium is an ever changing exhibition of beautiful and useful living things . . . a center of recreation for the masses of great educational value . . . "

Similarly, the New England Aquarium Corporation, which is promoting an aquarium for Boston, emphasizes "the great popularity of this type of institution in other parts of the world." In fact, that interest is felt to be so great that, once established, it is anticipated by the corporation that operating revenues of the proposed Boston aquarium will be adequate to meet the costs of operation and improvements.

This report presents attendance figures which demonstrate the popularity of aquariums. Thus, San Francisco's Steinhart Aquarium admits about 2,300,000 persons annually; Marineland of the Pacific almost as many, 2,000,000; and a half dozen other large aquariums a minimum annually of 500,000 persons each.

New aquariums are in the process of construction in Philadelphia, Pennsylvania, and Tacoma, Washington. Another aquarium at Dallas, Texas is being enlarged and the New England Aquarium Corporation hopes to build in Boston in the not too distant future.

AQUARIUM SPECIMENS AND EXHIBITS

Specimens for aquarium exhibition are obtained from many sources. They may be bought from dealers, caught locally, lured into fish traps or obtained through exchange with other aquariums. Judging by the experience at Woods Hole, an aquarium in Boston should have no difficulty in obtaining species peculiar to New England waters in view of the presence of the Boston Fish Pier and its fleet of trawlers and seiners. Seals could easily be obtained at nearby Boothbay Harbor, Maine.

Fish shows and spectaculars today are attracting large audiences to some aquariums. They increase aquarium popularity and earnings from admission charges Trained sea animals seem to attract young and old alike. In addition, large crowds enjoy watching the activities of fish and aquatic animals from vantage points below water level along the outer walls of large exhibition tanks.

AQUARIUM FINANCES AND OPERATION

Under the above arrangements, aquariums need not be a financial burden on a city, county or state when admission fees are charged and fish shows or spectaculars are staged to help improve attendance.

The cost of constructing a modern aquarium, including all of the necessary tanks and equipment is estimated to be between $40 and $50 a square foot. Original financing for today's public and private aquariums has come from various sources, such as trust funds, philanthropies, stock issues and foundations. Indeed, there seems to be no common denominator in this respect.

It is difficult to estimate aquarium costs without information as to size, number of exhibits, types of salt and fresh water fish and the like. Among the eight total aquarium construction costs given in the report, totals vary from only $102,000 for the aquarium at Fort Worth, Texas, to $3,250,000 for the magnificent Shedd aquarium in Chicago. The cost of rehabilitation alone for the Steinhart aquarium in San Francisco ran to $1,575,000.

The current operations of an aquarium, be it large or small, require a trained director and a competent staff. Wages have to be high enough to attract qualified personnel. As the report demon-

strates, resultant payrolls are therefore an important consideration in every aquarium budget.

The prime requisite for keeping aquatic animals in captivity is a plentiful supply of their natural element to which everything else is subordinate. The water supply must be pure and abundant. Moreover, all pipes and tanks must avoid metals or substances which rust or corrode and cause toxic conditions for aquatic animals.

The salt water of Boston's harbor has a high pollution count and is unfit for aquarium exhibition purposes. To meet this problem elsewhere some aquariums ship their salt water from distant points. This supply can be kept for long periods in adjacent storage tanks.

It would be possible to reduce the cost of a new Boston aquarium by using fresh water alone from the city's water supply. But, of course, such a limitation would prevent visitors from viewing sharks, sea turtles, octipi and many other salt water specimens of great interest Similarly, only cold water aquatic specimens could be exhibited to avoid the cost of warming the water. But, again, part of the price of such a decision is the elimination for spectators of their viewing of beautiful creatures of the sea from the warm waters of the world.

The Commonwealth of Massachusetts

AN MDC SEA AQUARIUM FOR SOUTH BOSTON

CHAPTER I. INTRODUCTION

Origin of Study

This study is based on the unnumbered House Order of 1962 which is reprinted on the inside of the front cover of this report. That Order called for a report on House, No. 2284 directing the Metropolitan District Commission (MDC) to construct and maintain a sea aquarium in the Castle Island section of the City of Boston.

House, No. 2284, introduced during the 1962 session of the General Court by Rep. John T. Tynan of Boston, proposed that to meet the construction costs of such a sea aquarium, the state treasurer shall, upon request of the governor and council, borrow not more than three million dollars by sale of bonds with terms of not more than thirty years. The bill further provided that the bonds shall pay such semi-annual interest as the state treasurer with the approval of the governor shall fix. All annual principal and interest payments on account of such obligations are to be paid by the members of the Metropolitan District Commission Park District on the basis of assessments annually levied on park members by statutory formula.

This proposal, House, No. 2284, was one of a series of almost identical proposals which Rep. Tynan has sponsored for the past half dozen years. All of them have been rejected by the General Court.

Former Boston Aquarium

For almost half a century — from 1912 until 1954 — the City of Boston maintained an attractive sea aquarium in the Castle Island section of South Boston. In the latter year the aquarium was forced to close because of a lack of suitable exhibits and badly needed rehabilitation which would have cost some $300,000.

When the aquarium opened fifty years ago it attracted much attention. Built at a cost of $149,530 from funds provided by the George F. Parkman Trust Fund, it contained 62 exhibition tanks varying in capacity from 45 to 1,500 gallons. In addition a special pool with a 4,500 gallon capacity was provided, along with 31 reserve tanks. Two large reservoirs made available a large reserve supply of water. Four water systems were used, as follows: (1) fresh water, (2) fresh refrigerated water, (3) salt water, and (4) heated salt water. A fish hatchery was maintained which produced 5,000 fry annually.[1]

At the height of its popularity the Boston aquarium had the large number of 2,904 exhibits on display, including 2,835 fishes, four mammals, 20 reptiles, 25 amphibians and 20 invertebrates. It was open daily to visitors from 10 a.m. to 5 p.m. No admission was charged. The number of visitors averaged about 300,000 annually, or about 844 a day. The aquarium personnel of 16 employees, included a director, a matron, four engineers, three firemen, one part-time engineer, a mechanic and five attendants.

Newspaper clippings indicate that more than 15,000 visitors tried to jam their way into the new aquarium on Sunday, Dec. 1, 1912, when it was first opened to the public. The throngs were reported to be so large that the building superintendent was obliged to close the doors three times to control the visitors.

When the defunct South Boston aquarium ceased operations in 1954, the then Mayor, John B. Hynes, is reported to have been hopeful that a new aquarium would replace it, to be located at the Charles River Dam as an adjunct of the Boston Museum of Science.[2]

Historical Background

The first known public aquarium among the cities of the world seems to have been opened to the public at Regents Park in London in 1853. It consisted of a series of standing tanks in a conservatory building. This meager setup was followed a decade later

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1 Charles H. Townsend, *The Public Aquarium, Its Construction, Equipment and Management*. U. S. Bureau of Fisheries Document No. 1045. 1928.

2 Statement by Bradford Washburn, Director of the Boston Museum of Science.

by P. T. Barnum's "Aquarial Gardens" an aquarium opened in Boston in 1862 at the corner of Washington and Court streets, then closed after operating a few years.

A few years later an aquarium was started in 1873 at Woods Hole, Massachusetts, by the U. S. Commission of Fish and Fisheries to serve as an adjunct to the investigation of commercial fishing in New England waters. Of other possible locations along the New England coast, Woods Hole was selected as the best for a combined laboratory and aquarium. Chief of the reasons for this decision was the fact that Cape Cod is the dividing line between northern and southern fauna. In addition, the location had good railroad service, and the government donated a site for its construction. The combined aquarium and marine biological laboratory created at Woods Hole was in line with the design of similar structures at Naples, Italy, which have been mentioned.

In 1893 the Italians opened an aquarium in Naples which became the first big marine biological laboratory in the world.

Shortly after the start of the World's Columbian Exposition in Chicago, the famous aquarium at the Battery in New York City was opened in 1894 on the site of an old military fort. It survived until 1941. Now the City of New York is helping to maintain its successor at nearby Coney Island, an amusement resort on the outskirts of that city.

Detroit opened an aquarium in 1904 and this popular structure is still in operation.

In addition to these efforts of big cities of America, the following list indicates a few of the localities which are either operating aquariums at this time or are in the process of constructing or rehabilitating them: Tacoma, Washington; San Francisco and Palos Verdes of California; Waikiki, Honolulu; Tucson, Arizona; Chicago, Illinois; Royal Oak, Michigan; Coney Island, New York; Cleveland, Toledo and Cincinnati of Ohio; Memphis, Tennessee; Woods Hole, Massachusetts; St. Augustine, Miami and Key West of Florida; and Dallas, Fort Worth and San Antonio of Texas.

A recent study indicates that 216 aquariums are now operating

throughout the world.[1] The study did not cover various nations of Africa and Central Asia to which no questionnaires were sent.

At the present time, support is being manifested for a national aquarium to replace a small inadequate exhibit in the basement of the Commerce Building in the Nation's Capital. To provide this new facility, Senator Clair Engle of California introduced a bill in the Senate to establish such an aquarium (Senate 2296) and Congressman Michael Kirwan of Ohio introduced a similar bill in Congress (House 8181).

Public Interest in Local Aquariums

Public interest in local aquariums has been indicated by various experts in the field as indicated below. Thus the late director of the now defunct New York Aquarium, who was a world renowned aquarist, summarized the evidence on this score over three decades ago in the following terms.[2]

> "No other form of public museum is of greater interest to the people. The plentifully stored aquarium is an ever-changing exhibition of beautiful and useful living things not easily seen in their natural habitat. It quickly becomes a center of recreation for the masses, contributing always towards a wholesome appreciation of nature.
>
> "It has great educational value, stimulating constant inquiry respecting our heritage of the waters which a wasteful civilization must take still greater pains to conserve."

During a recent interview similar views were expressed by Benjamin Fink, Director of the Park Division of the Metropolitan District Commission, as follows:

> "There is absolutely no doubt but what an aquarium of the type that Rep. Tynan has in mind would draw crowds. . .
>
> "Boston long has been a sea-faring city. Thousands of mid-westerners who have never seen a salt water fish and who visit here each summer would flock to a sea aquarium.
>
> "Sport fishing becomes more popular with each passing year, and such anglers would have a tremendous interest in this project. The educational interests accruing to school children as well as to various clubs and societies

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[1] Spencer Tinker and Miriam Omura. *Directory of Public Aquaria of the World.* Preliminary edition, 1962.

[2] Charles H. Townsend, *The Public Aquarium, Its Construction, Equipment and Management.* In report for U. S. Bureau of Fisheries, Dept. Commerce, Doc. 1045. 1928.

would be of untold value. Why some persons living right here today in seafaring and sea-loving Boston still can't differentiate between a mackerel and a cod, but they soon would if they had an aquarium to visit."

Attendance at local aquariums has been excellent, and accordingly the number of aquariums has been increasing rapidly since World War II. On this score, the Director of the Woods Hole, Massachusetts Aquarium reports that "during a three month summer period (of 1961) our small aquarium here had an attendance of 200,000. Sometimes we hosted as many as 6,000 visitors daily."

In similar vein, "Marineland" of the Pacific, at Palos Verdes, Calif., had a record number of 1.46 million paid admissions during the fiscal year ending April 1, 1961.

The Director of the Detroit Zoological Park writes:[1]

"Aquariums established in recent years have demonstrated that they are one of the few types of national history displays capable of paying their own way, even of being commercially profitable. The public interest that makes them so fortunate will probably cause many new aquariums to appear in the near future."

On the Boston scene, the brochure of the New England Aquarium Corporation, which is actively urging an aquarium for Boston, says in part:

"Evidence of the needs and use a public aquarium receives is the great popularity of this type of institution in other parts of the world. Our best estimates are that a public aquarium in this region will require only the initial creation contributions. There is every reason to believe that operating costs and improvements will be met by operating revenues."

There follows Table 1 giving attendance figures and admission fees for thirteen municipally or privately operated aquariums throughout the United States.

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[1] Keith K. Kreag of Detroit Zoological Park, Royal Oak, Michigan. In article in Drum and Croaker, house organ of Aquarium Research Science Endeavor. Vol. 59, No. 7.

TABLE 1

ATTENDANCE FIGURES AND ADMISSION CHARGES AT THIRTEEN LOCAL AQUARIUMS

Location of Aquariums	*Approx. Annual Attendance*	*Admission Charges*			*Free Days*
		Adult	*Child*	*Class*	
San Francisco, Cal.	2,300,000 (1959)	Free	Free	Free	All
California (1)	Not Avail.	$1.00	$0.50	Not Avail.	None
Marineland, Cal.	2,000,000	2.20	1.10	Same	None
Chicago, Ill.	700,000	0.25	Free	Free	Th., Sat., Sun.
Cincinnati, O. (Zoo)	700,000	Zoo Ch.			
Columbus, O. (Zoo)	650,000	Zoo Ch.	Free	Free	None
Marineland, Fla. (1)	600,000	2.20	1.10	0.75	None
Miami, Fla. (1)	600,000	2.20	1.10	Not Avail.	None
Fort Worth, Tex. (Zoo)	500,000 (1955)	0.20	0.10	Not Avail.	None
Toledo, O. (Zoo)	500,000	Summer Zoo Charge			Not-Avail.
New York, N. Y.	350,000	0.90	0.45	0.25	None
Vancouver, Canada	300,000	0.25	0.10	0.05	None
Key West, Fla. (1)	100,000	0.50	0.25	Free	None

(1) Privately operated aquariums.

CHAPTER II. LOCAL AQUARIUMS

Types of Aquariums

Aquariums fall into four general categories; (1) Private aquariums, (2) Public aquariums without zoo affiliations, (3) Public aquariums as integral parts of zoos, and (4) Some aquarium-zoo combinations located on separate sites.[1]

In addition, aquariums are divided into two classes according to scope of exhibits: (1) Aquariums which display only fresh water species, and (2) those which display both fresh and salt water species. Discussions of the aquarium now being proposed for Boston, stress the latter scope of exhibits including both types of fish.

The following paragraphs briefly summarize for illustrative purposes modern plans under way in three cities.

Philadelphia. This city is completing work on a new aquarium at a cost of about $2 million that will display both fresh and salt

[1] Keith K. Kreag of Detroit Zoological Park. In Drum and Croaker magazine, Vol. 59, No. 7. 1958.

water species of fish. The structure will include a porpoise theatre enclosed in glass, and also a large fresh water fish tank to provide for many different species. It will exhibit many unique fresh water animals living together as a group. Small tank displays will be used, along with an outdoor display area which will provide for such aquatic specimens as penguins and seals.

Tacoma, Washington. The new aquarium under construction in this city is expected to be completed by early 1963. The $250,000 building is located about 1,100 feet from the sea at an elevation of 135 feet. Water will be pumped into 60 tanks of capacities ranging from 50 to 2,000 gallons. In addition, a large center tank, 12 feet deep, will contain 135,000 gallons of water. Other tanks will include a seal pool — 30 feet by 25 feet by six feet deep, a porpoise pool — 30 feet in diameter and nine feet deep, and a penguin tank — 15 feet by 10 feet by three deep. For this and other equipment, the sum of $169,000 has been allocated in addition to the building cost cited above.

Dallas, Texas. A third illustration of an important aquarium development being completed is a marine addition to replace the north end of the present aquarium building at Dallas. This 68 foot extension is to house approximately 30 tanks for salt water exhibits, including one 10,000 gallon tank, two 2,000 gallon tanks, several 1,000 gallon tanks, and numerous smaller tanks ranging in capacity from 10 to 180 gallons.

Hawaii. The Waikiki Aquarium, administered by the University of Hawaii, has an interesting feature. Unlike most aquariums that light their corridor tanks artificially, this aquarium makes use of Oahu's continually sunny weather. The aquarium uses blue-tinted plastic roof panels that utilize the sun for lighting its corridor tanks.

Two Boston Proposals

The abandonment in 1954 of the old South Boston aquarium was accompanied by replacement hopes for a new aquarium in connection with the Boston Museum of Science. At that time, however, the Museum directors were reluctant to inaugurate a money-raising campaign for an aquarium, inasmuch as their efforts were con-

centrated on bringing about completion of the Science Park structure.

Perhaps the most comprehensive new aquarium undertaking and one of particular interest to residents of the Boston area is that of the New England Aquarium Corporation. It has a most interesting history. This private group was brought together by David K. Stone, Boston investment banker, to replace the defunct South Boston aquarium on a site elsewhere than at the present science center. Administrator of the new corporation is Edward Taft, formerly Exhibits Director for the Museum of Science. The Curator-Director of the new project is the eminent Lee C. Finneran. He was brought here from Detroit where he had been serving as Curator of the Detroit Zoological Park and Belle Isle Aquarium.

Directors of the corporation include Stone, as president; Henry Lyman, vice-president; Robert A. Lawrence, vice-president; William H. MacCrellish, Jr., secretary; Weston Howland, Jr., treasurer; Alexander Bright and Paul F. Hallmuth. The following group of Greater Bostonians comprises the charter members of the corporation:

Charles B. Barnes
Gerald W. Blakely, Jr.
Richard J. Borden
William S. Brewster
Jacob F. Brown, II
Samuel Cabot, Jr.
Charles E. Cheever
Stanley L. F. Chin
Francis W. Davis
Thomas A. Fulham
Daniel S. Gregory
William C. Hammond, Jr.
Alfred B. Hunt
G. Newell Hurd
Thomas M. Joyce
Robert J. McMullan
Frank J. Mather, III
Arthur G. Mitton, Jr.
Francis W. Sargent
William B. Snow
Robert G. Stone
Edward Taft
Webb B. White

This group believes that its aquarium project should be undertaken as a separate private enterprise, rather than as part of a unified science center. It has started a fund-raising drive for three million dollars and is expected shortly to announce its technical plans.

The members of the other group which argues that any sea aquarium should be a part of the Museum of Science emphasize

that such a combination would cut the cost of overhead by at least 25 per cent. The combined setup would bring economies through requiring only one director, one set of guards, a single lighting and heating plant, and other savings.

A preliminary brochure of the independent, non-profit New England Aquarium Corporation indicates that the contemplated enterprise is to be the equal of anything of its kind in the world today. Its proposed structure is tentatively planned for location somewhere on the Atlantic Avenue waterfront in Boston. The corporation believes that a public aquarium here will require only an initial contribution to become an operating entity. Thereafter admission charges will pay for operation and maintenance costs, and it will become self-supporting.

The new aquarium would present live exhibits of fresh and salt water animals, necessary additional exhibits to explain aquatic environment, and exhibits to demonstrate the commercial, recreational and historical influences of the aquatic world on mankind. In addition the aquarium will provide facilities for research in fish life, oceanography and conservation.

It is the corporation's hope that various sections of this proposed aquarium will be of interest to various groups such as students, fishermen, tourists, hobbyists, scientists and the maritime industry.

Among the features of the proposed aquarium will be a gigantic 40 foot waterfall in the principal display hall to emphasize the importance of water "cycling from heavens to earth." The waterfall tower required to achieve this effect will be an exterior landmark, and will also contain much of the filtering equipment of the aquarium.

A snow room for penguins will show these living birds in their natural environment, standing sentinel on ice floes or swimming under water. On the other hand, tropical salt water fishes of many varieties will be seen in coral reef habitats.

A children's aquarium will be equipped to provide knowledge of the aquatic world to youngsters. Thus, this department will have peripheral live exhibits of aquatic animals that appeal to children. Centrally featured will be an auditorium and stage to demonstrate such things as electric eels, and to show microprojector images and natural history films.

Displays and Specimens

Displays in the new aquarium planned for Boston will vary considerably according to the type and size of live specimens to be exhibited. In view of its proposed size and composition both salt and fresh water fish will probably be exhibited along with local and tropical varieties. Fish that can be caught locally will of course be relatively inexpensive. Commercial dealers usually can make a fair number of tropical fish available in small sizes.

At Woods Hole, for example, the aquarium obtains off shore specimens from draggers operating out of that port. The aquarium also stocks some 38 species of fish at nominal cost by subsidizing a privately owned fish trap in Quisset Harbor in Buzzards Bay, only a short distance from the aquarium. This trap provides more than half the total number of aquarium exhibits, including scup, blue fish, sea robbins, sea bass, tautog, various kinds of herring, shad, alewives, fluke, flounder, mackerel and bonito. During the summer months the trap also provides trigger fish and file fish, which are southern species that migrate to the Woods Hole area during the warmer season.

Similarly, a Boston sea aquarium might obtain many New England fish specimens from the big beam trawlers operating out of the Boston Fish Pier.

Seals, always a popular aquarium exhibit, might be easily and inexpensively provided. The pair of seals on exhibit at Woods Hole were caught at Boothbay Harbor, Maine, when they were about three months old. Similarly, seal lions can be used for popular and entertaining displays. They currently sell for about $120 each at San Diego, California.

The porpoise is another popular marine comic that a Boston aquarium would need. Marineland in Florida was one of the first aquariums which successfully kept porpoises in captivity over prolonged periods. This sea animal can remain out of water much longer than it can stay submerged, provided its soft, rubbery skin is kept wet. Two porpoises were shipped to New York by truck and were out of water for 33 hours without ill effect. They were cushioned on ordinary mattresses but wrapped in moist bed sheets throughout the trip.

At the Shedd aquarium in Chicago it is not at all unusual in the autumn at the end of a collecting season to have an average of 10,000 aquatic specimens on hand, representing about 250 distinct species. This count excludes young hatchery fish which are too small to be used for exhibition purposes.

The acquisition of this large collection of fish by this inland aquarium requires the special equipment which is provided by the aquarium's collecting car "Nautilus." During a normal collecting season the Nautilus travels more than 20,000 miles, and visits such widely separated ports as Boothbay Harbor, Maine, Los Angeles, California, and Key West, Florida, as well as many intermediate points.

This railroad car serving the Chicago aquarium is in effect a miniature travelling aquarium with three separate water systems, one of which can be refrigerated as needed. Air for the normal compliment of 15 wooden tanks and 20 cans is furnished by a compressor.

The Vaughan Aquarium in California uses a 14 foot fibre glass skiff to obtain specimens, particularly marine creatures peculiar to Southern California. The skiff is equipped with a seven and one-half horsepower outboard motor which serves for the setting of traps and set lines, for hand line fishing, and for seining operations at bays and beaches some distance from the aquarium.

At Vancouver, specimens are obtained from many different sources. Most of the tropical fresh water species are purchased from local dealers who get them from fish breeders in New York, Florida, California, Hong Kong and other places. Sometimes they are bought directly from collectors in South America.

Many of the common species are bred in the aquarium and kept on reserve until needed for display. Rare ones are occasionally acquired through exchange with other public aquariums. Fresh water creatures have been obtained from the New York and Fort Worth aquariums.

Tropical marine fishes are purchased from dealers in Florida and California, and also have been received for the Waikiki Aquarium in Honolulu, the Steinhart aquarium in San Francisco, Marineland of the Pacific at Los Angeles, and from Miami Seaquarium.

Most cold water aquatic specimens can be collected locally, but some exotic species are available through exchange and purchase. Among these sources are the above aquariums, the aquariums at Woods Hole, Massachusetts and at the University of Toronto in Ontario, Canada, and Nova Scotian fishing concerns. On one occasion the Japanese government donated several unusual plants found only in a lake in northern Japan.

Fresh water and many marine fishes are captured in seines. Invertebrates are gathered on the shore at low tide or captured in traps. Most anemones, sea pens, red sea urchins, unusual star fish, tunicates and crinods are obtained by amateur divers.

Fish Shows

Unlike conventional aquariums where various fish species are exhibited in tanks and pools, some aquariums throughout the country today also stage spectacular shows during which trained sea animals perform a variety of tricks. Thus, the Marine Studios at Marineland, Florida, supplement a continuous exhibit of various fish with six such entertainments daily.

During the shows porpoises leap from the water to take food from the hands of attendants. They play a form of football, basketball and baseball, and one of them leaps through a paper-covered hoop. Pilot whales also perform interesting feats.

A diver descends into a gigantic pool and hand-feeds thousands of fish, including Moray eels, sting rays, sawfish and many game and reef fishes. This performance is viewed by hundreds of spectators in the audience through windows below water level in the sides of a large circular tank.

This aquarium is served by a motel, a restaurant, a bar, gift and fruit shops, and a service station. Its show and exhibits have attracted millions of spectators, each of whom pays an admission fee.

Marineland of the Pacific, at Palos Verdes, California, not only exhibits large ocean mammals and fish in its oceanarium, but has extensive outdoor facilities for presenting performances by trained aquatic animals .

CHAPTER III. AQUARIUM FINANCE

Construction Costs

Estimates of construction costs for a sea aquarium depend on such factors as how large it is to be, the number and type of specimens to be displayed, and whether it will show fresh water, salt water or both types of fish. Obviously a small zoo with a few aquarium aspects, can be built for a good deal less than the magnificent aquariums that grace cities such as Chicago, San Francisco and New York, and the one soon to be opened in Philadelphia.

One experienced official, Director Coates of the New York Zoological Society, estimates that total costs of aquarium construction varies between $40 and $50 per square foot. This figure includes all of the machinery, piping and tanks necessary for a good, modern aquarium.

Another trained aquarist, Director Finneran of the New England Aquarium Corporation, places those construction costs at about $40 the square foot. He points out that this figure was the average cost for aquariums built or building at the four following locations: Philadelphia, Pa.; Memphis, Tenn.; Yankton, S.D.; and Woods Hole Mass.

To indicate the costs of various special features that can be built into a complete aquarium, the following Table 2 lists cost estimates by the New England Aquarium Corporation to provide features in the aquarium building which it hopes to construct in the Boston area.

TABLE 2

ESTIMATED COSTS OF VARIOUS ASPECTS OF PROPOSED BOSTON AQUARIUM PROJECT

	Costs
Giant Oceanarium Tank for large sea creatures	$ 500,000
Research Laboratory to study fisheries, oceanography and conservation	100,000
Penguin Exhibit	100,000
Demonstration Tank	100,000
Coral Reef Room	50,000
Jewel Animal Room	50,000
Pure Science Laboratory	25,000
Tidal Pools	15,000
Natural History Dioramas (upper cost range for miniature three dimensional scenes)	10,000
Fisherman's Identification Tank	2,000

To provide comparative data on the total costs of aquariums built during the past 35 years, Table 3 is presented below:

TABLE 3

TOTAL CONSTRUCTION COSTS OF VARIOUS AQUARIUMS

Location of Aquariums	*Costs*
Shedd at Chicago, Ill.	$ 3,250,000
Philadelphia, Pa.	2,000,000
San Francisco (rehabilitation)	1,575,000
Saunderstown, R.I. (proposed)	550,000
Tacoma, Wash.	419,000
Woods Hole, Mass.	350,000
Memphis, Tenn. (approx.)	125,000
J. E. Record Aquarium at Fort Worth, Tex.	102,000

Pipes and Fittings

An expensive factor in present day aquarium construction is concerned with pipes, pumps, valves and fittings. Some aquarists believe all of these facilities should be made of tough, durable poly vinyl chloride (PVC) which does not rust or corrode and is non-toxic for aquatic animals.

Such material has been used throughout the aquarium at Woods Hole. The Director of that installation reports the results to be entirely satisfactory. The product, while expensive, is designed to last a lifetime, and best of all, it has ended a contamination problem which has long troubled aquarists who used metal pipes and fixtures.

This material is being used for all the piping in the new San Francisco aquarium reconstruction. The Steinhart Aquarium of that city closed its doors last spring after 39 years of operation and is undertaking a rehabilitation program to cost $1.6 million. For valves, rubber-lined Chemtrol and some Ace hard rubber is being used. Its eight water systems are being equipped for ultra-violet sterilization.

At Vancouver's aquarium in Canada no sea water will come into contact with any metal. All of its pipes and fittings are to be constructed of polyethlene plastic, hard rubber or asbestos concrete. Thus, many problems of toxicity, electrolysis and corrosion, which

are usually associated with the use of metals exposed to salt water, are expected to be avoided.

In the past some aquariums have used lead pipe which corrodes very slowly when in contact with salt water. But unfortunately such closed water systems produce quantities of metallic salts which though small are nevertheless extremely poisonous to fish specimens on display. In contrast, pure cast iron pipes produce no harmful salts, but corrode rather rapidly. Hard rubber piping has been found to be costly and is fragile.

"Transite", a combination of asbestos and cement, has been used for a long pipe extending from the sea to the storage tank of the T. Wayland Vaughan Aquarium at LaJolla, California, but the results of that installation are not yet known. Since this product is somewhat difficult to work with, cannot be bent, is not available in necessary small sizes for the distributing system, and has a limited choice of fittings, aquarium officials turned to expensive PVC for smaller pipes. The latter PVC product has the great advantage that it can be cut and threaded with standard tools, and welded by using certain solvents. Moreover, it can be softened by heat which permits it to be bent in small curves.

Maintenance Costs

Here again it is most difficult to compare maintenance costs without more adequate information on probable aquarium design and dimensions. Included are questions as to the size of the contemplated aquarium, admission charges, the inclusion or exclusion of fish shows, and the availability of aquarium revenue producers, such as restaurants, book stores, gift shops or novelty counters. The latter features have all proved productive in other aquariums throughout the United States and Canada.

Personnel Costs

The payroll of the proposed aquarium is bound to be of great importance. It is clear that today's modern aquariums, large or small, cannot be well operated without a trained director, assisted

by a competent staff. Such personnel cannot be attracted and held unless the salaries which are paid compare favorably with those forthcoming at the other big aquariums throughout the nation. Certainly, salaries and wages will constitute a sizable, if not the largest item, in the budget of the new proposed large aquarium for Boston.

The importance of this payroll problem is indicated by the experience of the New York aquarium at Coney Island. Its director reports that in the past:

> ". . . four and one-half years ending December 1961 that we were open, our net losses have been in the order of $400,000 . . . largely due to the Civil Service status of our employees, none of whom can be laid off in slack times and all of whom accrue salary and raises equivalent to those paid by the city in its own operations. The importance of this, of course, is that our present location is very definitely seasonal and about 75 per cent of our revenue must be procured during the summer three months.
>
> "To offset this unfortunate picture which was plagued by our constant building program, we might say that this year we went into the black about the middle of August and will be very little, if any, in the red by the end of the year."

The Coney Island Aquarium Director, Mr. Coates, added that $10,000 of the annual deficits at his aquarium have been met by the city, and the remainder by the New York Zoological Society.

As shown by Table 4, 60.4% of total expenditures during 1961 at the Vancouver aquarium was used for salaries and wages which were by far its largest object of expenditure ($46,530 out of $77,030). This payroll provided a staff consisting of engineer, biologist-collector, ciologist-technician, tropical aquarist, cold water aquarist, artist, secretary, cashier and caretaker and several part-time employees.

At the much larger Shedd aquarium in Chicago, the annual average maintenance expenditures amounted to $375,070 in 1960, including the salaries of some 40 employees. Its condensed report for that year is reproduced in Table 5.

TABLE 4

RECEIPTS AND EXPENDITURES AT VANCOUVER PUBLIC AQUARIUM

CALENDAR YEAR 1961

Receipts:	
Admission	$ 72,510.00
Less Amusement Tax	3,354.57
	69,155.43
Sale of Novelties	23,456.46
Less Cost of Sales	14,763.79
	8,692.67
Proportion of Memberships	300.00
Miscellaneous	2,643.72
Total Revenue	$ 80,791.82
Expenditures:	
Salaries and Wages	$ 46,529.51
Light, Power and Fuel	8,267.25
Repair and Maintenance	3,480.29
Biological and Exhibit Costs	2,514.09
Operating Supply	2,092.17
Publicity	2,078.40
Fish Feed	1,853.13
Pension Plan	1,391.16
Auto and Truck	1,384.07
Office Expenses	1,119.91
All Other	6,319.51
Total Expenditures	$ 77,029.69
Gross Operating Surplus	$ 3,762.13
Non-recurring Expend. (Passes; Depr.; etc.)	$ 1,869.40
Net Operating Surplus	$ 1,892.73

TABLE 5

RECEIPTS AND EXPENDITURES AT SHEDD AQUARIUM IN CHICAGO

FOR YEAR 1960

Receipts:	
Chicago Park District	$ 262,469
Admissions	30,595
Income from Shedd Aquarium Society	93,833
Miscellaneous Income	210
Total Receipts	$ 387,106
Expenditures:	
Salaries, including Pension & S. S. Taxes	$ 222,847
Heat, Light, and Power	30,631
Collecting Exhibits	12,991
Supplies	9,336
General Expense and Repairs	9,266
	$ 285,070
Provision for Reserve Funds	90,000
Total Expenditure	$ 375,070
Excess of Receipts over Expenditures	$ 12,035

Note: Figures will not add correctly because rounded.
Source: Condensed Annual Report of Shedd Aquarium, Chicago, Ill., Fiscal year 1960.

Payroll costs also dominate the financing of the T. Wayland Vaughan Aquarium and Museum of the University of California at La Jolla, California. Its total yearly payroll amounts to about $25,000 for five staff members. Operating expenses cannot readily be stated, because some expenses for items such as lighting, gardening, building repair and maintenance are not charged directly to the aquarium, but to general expenses of the university campus. The latter expenses total to only about $1,725 a year, being made up of (costs shown parenthetically) fish food ($350), telephones ($300), lights and heaters ($250) and five other items (ranging from $200 down to $100 each).

Initial Benefactions and Other Financing

The special gifts and other bases surrounding establishment of various important local aquariums inside and outside Massachusetts are indicated below.

The former aquarium in South Boston was built with funds from the George F. Parkman Trust Fund, whereas the Massachusetts aquarium in operation at Woods Hole, was built with federal funds.

In Chicago, the magnificent aquarium structure located on its lake shore resulted from the gift of $3,000,000 for the purpose in 1926 from the late philanthropist, John G. Shedd.

On the West coast, the private aquarium, Marineland of the Pacific, came into being as a business venture, with corporate stock being sold to raise funds. Also on the West coast, the funds provided by the Scripps Institution of Oceanography were responsible for the T. Wayland Vaughan Aquarium located at La Jolla, California.

In Texas, the Amon G. Carter Foundation provided the funds for the James R. Record Aquarium at Fort Worth.

In Tennessee, the aquarium structure at Memphis was provided by the $100,000 gift of an anonymous donor said to have come originally from Boston who specified that an admission fee of 25 cents was to be charged adults while children were to pay ten cents each. Moreover, gross receipts were to be used solely to purchase additional animals for the aquarium collection.

In Honolulu, the aquarium at Waikiki was orginally the property of a street car company. Back in the 1880's the Honolulu Rapid Transit Company wished to build some sort of attraction at the end of its transit line at Kapiolani Park, which would entice patrons to ride to the end of the line. The idea for an aquarium stemmed from the impression made on one of the owners of the company during a visit to the aquarium in Naples, Italy. With the help of two other company directors, $8500 was raised to construct one of the world's oldest aquariums. In 1919 the Hawaiian Legislature assigned the aquarium to the University of Hawaii which continues to administer it.

At Vancouver, Canada, construction costs of an aquarium were met by grants of $100,000 each from the Government of Canada,

the Province of Columbia and the City of Vancouver. The city also donated the land upon which the building was constructed. All equipment costs were met by the private, non-profit association which operates the aquarium.

In New York City, the original Aquarium at the Battery was founded by the local government in 1894, and was located in a former Federal Immigration Station. It was operated under municipal auspices for the first eight years. After the turn of the century the New York Zoological Society was requested to take over its management under an agreement whereby the city paid all maintenance costs while the Society provided for the collection of all specimens and did related scientific work.

The construction in 1941 of an entrance to the Battery Brooklyn tunnel under the harbor necessitated closing the aquarium. During World War II and the post-war years, increasing costs and the shortage of materials prevented construction of a new aquarium. However, a 15-acre site at Coney Island on New York City Park property was made available. The city and the New York Zoological Society jointly built and stocked a new aquarium structure, which in 1957 began admitting adults for an admission fee of 90 cents, and one-half that amount for children.

Today, the institution is still owned by the city and operated by the Zoological Society. Last year, the city assumed some of the latter's housekeeping charges to help meet the annual deficits of recent years.

CHAPTER IV. OPERATION OF AN AQUARIUM

Aquarium Water Requirements

The vital requisite for keeping aquatic animals in captivity is of course, a plentiful supply of proper water. No mechanical equipment can make up for deficiencies in this respect. The water supply must be pure and abundant, whether for salt water or fresh water exhibits. Water that has been treated with chlorine is not suitable.

At Waikiki all of the crystal clear water at the aquarium is pumped from a well 40 foot deep. Ocean water filters into the well

through an ancient coral reef, and an elaborate and expensive filtering system has therefore been avoided.

The Shedd Aquarium in Chicago ships its salt water in tank cars from Key West, Florida. While 160 tank cars are required to fill the reservoirs of the aquarium, this supply is sufficient for many years when properly cared for. As to the fresh water aspects of Shedd Aquarium needs, the supply is pumped directly out of adjacent Lake Michigan through the aquarium's own intake system.

Boston Situation

The sea aquarium which is being discussed for Boston would have six water systems using: (1) Hot salt water, (2) refrigerated salt water, (3) hot fresh water, (4) refrigerated fresh water, (5) salt water at "room" temperature, and (6) fresh water at "room" temperature.

Some persons assume that a Castle Island location for Boston's aquarium would be admirable for inexpensive tapping of the salt water of Boston harbor. Unfortunately, however, Boston harbor water is polluted and unfit for aquarium exhibits, in the opinion of qualified experts. Water for this purpose must be free of pollution.

The Woods Hole aquarium of Massachusetts is much more fortunate in this respect since it is able to draw salt water directly from the harbor without fear of pollution. During the winter months this water is too cold and must be heated to a range of from 65 to 70 degrees before it can be used.

To meet the pollution problem for a Boston aquarium, three types of action are considered possible.

(1) A large intake line could be built extending seaward to the 40 foot main foot channel. Unpolluted water could then be pumped at high tide into storage reservoirs sunk in the ground at Castle Island.

(2) Salt water could be brought to Boston as ballast in empty vessels. Such water, however, would have to be filtered through beds of charcoal to remove impurities acquired en route.

(3) Finally, and the least satisfactory method, would be the manufacture of sea water, a costly operation.

An aquarium can be built at Boston which exhibits only fresh water animals. Its cost would be considerably less than that of a sea aquarium, since simple water connections with the city's water supply would suffice for a fresh water aquarium. Among other things this limitation would avoid the operation and maintenance of pumps to circulate a supply of sea water. But the necessary restriction of exhibits to fresh water aquatic animals alone would of course than prevent visitors viewing interesting salt water specimens of great interest such as octopi, sharks, giant sea turtles, tarpon, jewfish, rays and the like.

Tanks, Drains, Appearance

Display tanks are one of the most important features of any aquarium if the interest of visitors is to be held. The sizes of such tanks to be installed in the contemplated South Boston sea aquarium would necessarily vary with the scope and nature of the proposed exhibits. Tanks about eight feet square make a very good size for a wide variety of medium sized fishes from many latitudes. In addition a good many smaller tanks, decreasing to dimensions of about four feet long and two feet wide, should be available. These tanks are useful in displaying a great variety of very beautiful small fishes under conditions that avoid clashes due to temperamental or water considerations.

All tanks should have water about three or four feet deep, excepting possibly the smallest of the tanks which should be at least two feet in depth.

The Director of the New York Zoological Society also emphasizes the usefulness of really large tanks. Thus, tanks at the New York Aquarium of approximately 14 feet by 16 feet surface dimensions are only adequate for the exhibition of small sharks. Inasmuch as sharks are a "must" in any aquarium set of exhibits, at least one or two tanks should be at least this size or, preferably, larger.

If large animals such as whales or porpoises are to be shown, and these should certainly be considered, tanks of about 50 feet length should be considered with water depths starting at eight feet. On this score, while some northern whales are available, very few northern porpoises have ever been caught which are at

home in cold water. Hence, to exhibit the usual southern types of these marine animals would necessitate both warm water and covered conditions, since these southern animals cannot stand New England's cold climate.

The operation of the latter tanks should be on the basis of "closed" sea water systems. In "closed" systems the water is run in a constant stream through the exhibition tanks, on through filters and reservoirs, back into the exhibition tanks. This closed circuit makes possible the necessary adjustment of the water to the kinds of fishes in the tanks, both as to chemistry and as to temperature, if they are to survive and prosper. Good aquariums, in the opinion of experts, should contain half as many closed systems as there are exhibition tanks inasmuch as the needs of fishes are extremely varied.

At the aquarium in Woods Hole, Massachusetts, the tanks have the capacities shown in the following Table 6:

TABLE 6

CAPACITIES OF TANKS INSTALLED AT WOODS HOLE AQUARIUM, MASSACHUSETTS

No. of Tanks	*Tank Capacities in Gallons*
One	2,800
Five	750
One	650
One	400
Three	250
Three	200
Two	100

Several of the tanks are supplied with carefully regulated chilled sea water that is recirculated through filters, rechilled and then pumped back to the tanks. To make their contents attractive to the public these tanks are nicely decorated with rocks, sand, starfish, plants, clams, crabs, scallops, various species of marine flora and fauna, and items of underwater bric-a-brac. Artificial props such as sea clams, oysters, eel grass, quohaugs or even marine plants are bought nowadays by aquarists to help dress up exhibition tanks.

For cleanliness, it is important that all tanks be equipped with botton drains with valve attachments to facilitate cleaning operations. Uneaten food can cause a serious water pollution problem in exhibition tanks and should be expelled.

The James R. Record Aquarium in Forest Park at Fort Worth, Texas, has been attracting good audiences ever since it opened in 1954. An outstanding exterior feature of this aquarium building is the "living picture" tank over the entrance where fancy and colorful gold fish are displayed. The aquarium contains a total of 98 tanks, excluding those used for reserve, as listed by number and capacity in the following Table 7:

TABLE 7

NUMBER, CAPACITIES, AND USE OF TANKS IN AQUARIUM AT FORT WORTH, TEXAS

No. of Tanks	*Aquatic Specimens to be Exhibited*	*Capacity in Gallons*
17	Large native fish	400-2000
30	Exotic fish	25-280
6	Aquatic reptiles	30
14	Small native fish	12-25
10	Amphibians	12-25
1	Electric eel	120
3	Decorative	75
8	Changing exhibit tanks	18
9	Marine	12-350
98	TOTAL	

Shedd's Chicago aquarium has a large pool of 37,000 gallons. In addition it has 138 exhibition tanks, of which the largest are 30 feet in length, 10 feet in width and six feet in depth, and hold approximately 13,500 gallons. Its smallest tanks are 3.5 feet long, 3.5 feet wide and 5.0 feet deep, and hold about 445 gallons each. Another 95 reserve tanks are in use, graded in size to correspond with the exhibition tanks. They hold reserve stock and accommodate the specimens which must be withdrawn from exhibit while their quarters are being cleaned.

The Chicago aquarium tanks are constructed of concrete. They provide for five separate water systems using both heated and chilled salt water, both heated and chilled fresh water, and ambient fresh water.