A PHYSICAL DESIGN STUDY OF A ZOOLOGICAL PARK
FOR THE METROPOLITAN BOSTON AREA

A Thesis submitted in partial fulfillment
of the Requirements for the Degree of
Master of Architecture at
Massachusetts Institute of Technology

Submitted: August 1956

To:
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Indian Tiger
ABSTRACT

A PHYSICAL DESIGN STUDY OF A ZOOLOGICAL PARK FOR THE BOSTON AREA
by JOHN I. SCHLOSSMAN.
SUBMITTED FOR THE DEGREE OF MASTER OF ARCHITECTURE
ON AUGUST 20, 1956

This Architectural Thesis is proposed as the physical study of a new zoo for the Metropolitan Boston area; an area of varied temperature and weather conditions which have direct effect on enclosure of environment. The relationships of animal and enclosure, animal and spectator, and animal and maintenance are intentions of this study.

The existing zoos (the Franklin Park zoo and the Middlesex Fells zoo) are inadequate at the present time and offer no credit to the City of Boston as a point of pride nor great enjoyment to the visitor for whom the zoos have been created. The funds of Boston cannot adequately support more than one zoo and cannot support even that as long as there exists no desire to do so on the part of those concerned. There are many who are concerned but unfortunately are not in a position to do so.

There have been recent studies on the revitalization and expansion of present facilities at Franklin Park. These have been conclusive as to the needs of the zoo and the means of handling economic and administrative problems involved. It is upon much of this research that my solution is based. They have been inconclusive in actual design which is the reason for this thesis.

It is my belief that a zoo is that part of the city reserved for the habitation of animals at their scale. The role of the spectator is that of a welcomed observer whose presence for the most part has little effect upon the natural routine of the animal who has been displayed before him in dramatic natural surround.
In partial fulfillment of the requirements for the degree of Master in Architecture, I wish to submit for your approval my thesis subject, "A Physical Design Study of a Zoological Park for the Metropolitan Boston Area".

A visit to the long-existent Franklin Park Zoo in Boston impresses the visitor with the need for new and better zoo facilities for the Boston area; facilities more sensitive to natural animal habitat and which provide the visitor with more exciting opportunities to experience the natural environment. To my knowledge there is no zoological park now in existence which unifies these elements in the design of a total zoo environment. This investigation can be of value to future zoo design and in view of the deplorable existing zoo conditions in Boston, is a much needed development for this area.

I therefore feel that this subject is worthwhile, of timely significance, and exciting to pursue as a thesis.

Sincerely yours,

John I. Schlussman
Addax Antelope, Northern deserts, Africa
Green Mamba, Africa
I AM INDEBTED TO those who have assisted me in the preparation of this thesis and whose criticism helped to bring it to its final conclusion. They are the following:

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M.I.T., Cambridge, Massachusetts

THE INTERESTED FRIENDS WITH WHOM DISCUSSION  
BROUGHT FORTH NEW IDEAS
Mississippi Alligator
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DEDICATION

TO THOSE HUMAN ANIMALS IN THE SOCIAL CAGES OF THIS SPHERICAL ZOO WHO NOW AND THEN STROLL THROUGH THE BARS OF INHIBITION AND PAST THE WALLS OF INTOLERANCE
ADVANTAGES AND BENEFITS OF A ZOO

A zoo is a habitat for animals. Yet the entire reason for its being is the display of these animals before the public.

Primary among the advantages of a zoo is the enjoyment derived from the total zoological environment. To most it is the unusual experience of viewing animals foreign to the area in which the observers live. For many it is the opportunity to spend leisure time in open air among trees and quiet—a needed relief from the overly congested city, yet within reach of its center. For purposes of enjoyment a zoo is generally considered to be a summertime activity; the fact that enjoyment is the primary reason for zoo attendance being exemplified by the large season attendance during the three summer months.

The other important advantage of a zoo is that of educational value. While this is not unimportant in the summer months its importance increases when schools are in session and those interested only in the enjoyable surroundings are not overcrowding many exhibits. As a supplement to certain classroom study the zoo may be unsurpassed though inconvenient location and inclement weather have prevented more extensive use of facilities in many areas.

Of additional educational value is the research which is implemented at the park. This often gives new knowledge of animals, disease, and cross-breeding of certain specimens.

Though the expense of zoo building and upkeep is not small, from the standpoint of participant cost the zoo is a most economical recreational form.

A good zoo is a point of pride and interest to the community and may be a source of added income to the surrounding commercial area by business derived from zoo goers.

The foremost reason for the creation of a zoological park
nevertheless is the enjoyment derived by visitors from the experience of animals, recreational facilities and natural landscape.
ANALYSIS OF PAST WORK
ANALYSIS OF WORK DONE ON PROJECT TO DATE AND PRESENT SITUATION

In 1952 an M.I.T. thesis was submitted by Don P. Schlegel in which he proposed a "Redevelopment of Franklin Park Zoo". The research Mr. Schlegel did on present day zoos and the history of Franklin Park Zoo is excellently detailed, and gives a complete picture of the zoo situation in Boston up to 1952. I therefore feel that a duplication of this information here would not be of value. However, included here is a brief summary of his conclusions about the existing Franklin Park Zoo.

Of advantage to the present zoo location is the ease of accessibility by public transportation. He stresses as the principal disadvantage of the site its lack of natural water for which artificial supply compensates. Expansion also appears to be somewhat of a problem in the surrounding area, for while the site is wooded it is not available to the zoo for expansion of the facilities. The present exhibit is far from complete and in redevelopment the housing of future acquisitions seems difficult to accomplish.

Mr. Schlegel has confined himself to the present area and developed within the available 75 acres incorporating artificial lakes and ponds.

In regard to structures Mr. Schlegel feels that "only the Flight Cage and the Bear Dens are worth-while as a functional expression of zoo architecture," and goes on to say that "the exterior of all the buildings is in a neglected condition presenting an unsightly picture of deterioration."¹ He also relates that, untrue to the original plan, the structures are conspicuous, playing more than a minor role to the main purpose of animal exhibition.

However, due to the immediate necessity for expansion the present structures must remain to be remodeled at later date and to serve as a basis for design.2

With due respect to Mr. Schlegel for the fine research into the Franklin Park Zoo and the analysis of present day zoos, I cannot concur that this is a sound basis of design. Granted that the access to the Park is easy and the financial situation limits the nature of redevelopment, the best Boston may have on the basis of such redevelopment is a secondary solution. The problem, however, has been presented in an imaginative manner.

A more recent and less imaginative "Plan for the Future" of Franklin Park Zoo was proposed in 1954 by landscape architects Shurcliff and Shurcliff. They also justify the site on the basis of its public transportation access and apparently because of location, size, and the present completeness of the zoo buildings "it appears absurd to discuss moving the zoo to any other location in the city."3 The report is wisely based on the financial competence of maintaining the present zoo and proposes a 12-year plan costing $4,015,520 for construction plus an additional $464,660 in operating fees. This appears to be an excellent cost analysis worth following in any case of action, and proposes methods of self support including parking fees, gate admissions, income from a miniature railroad, television and films and public toilets, among others. Similar figures (and in many cases the same figures) can be applied to a zoo of any location. Furthermore no major construction has occurred in the last twenty years, so, according to any suitable plan for amortization of the buildings (though they may not have amortized themselves) they have come close to if not past their intended usefulness.

2Schlegel, op. cit., p. 73
3Franklin Park Zoo, A Plan for the Future, a publication of the Boston Park Department, by Shurcliff and Shurcliff, Landscape Architects, 1954. p. 5
This alone would not be reason to abandon use of the existing buildings, but add to it the poor state of existence Mr. Schlegel describes and the cost of repair and additions which Shurcliff and Shurcliff estimate, and thoughts of a new park while finding new use for the existing park do not appear unreasonable.

In addition to many entirely new facilities the following repair costs will have to be made to existing structures.

For the Bird House, a building constructed in 1913-14 at a cost of $107,102, the estimated cost of improvements is now $75,000. The Lion House, built in 1920 at a cost of $61,095, will cost $231,200 to repair and expand; the Elephant House, at an original cost of $28,311 in 1914, now will cost $86,500 to meet the present needs; and $142,500 must be spent to bring up to date the Antelope House constructed in 1930 for $41,000. Admittedly the cost of new facilities will run higher than the above figures, but in return it will offer in addition to new structures, the advantages of recent thought in zoo planning, whereas redevelopment will still leave the zoo with the existing eclectic structures and revisions of an outmoded site plan. These factors could not have been overlooked by the landscape architects, so their decision to redevelop must have been made on the value of the present location rather than on structural qualities.

Unfortunately, the physical limitations of this plan are the same as those of Mr. Schlegel, and since this plan is based primarily on a cost analysis it fails to incorporate many of the imaginative devices of the latter. The present formal approach, termed "The Greeting," is kept, but is cut to half its length near the center by the new Reptile House. Most of the present facilities are kept in their present location and other additions of note include the Monkey House, waterfowl lagoon, a site for an amphitheatre and a miniature railroad isolated in a far corner of the
Hope for Franklin Park

There is hope for the Franklin Park Zoo in the MDC's new development program. The present zoo is run-down, inadequate, badly laid out—since the original project never was completed.

Two years ago a plan for refurbishing the zoo—it would have cost $4,000,000—was proposed. Nothing ever came of it.

Now the MDC plan brings up the possibility of that agency taking over Franklin Park. "Experience... has shown," says the report, "that to have a first-class facility, a metropolitan area the size of Boston should support only one major zoo, because of the expense of construction and operating... The construction and operation of the zoo should be a joint effort of the Commission, private groups, universities and state and federal agencies with special interest in research and education in zoological and natural science fields."

The Commission already has one zoo, in Middlesex Fells. The report suggests that small regional zoos could eventually be provided in key reservations. But the emphasis should be on Franklin Park. The regional zoos would cost about $1,000,000. Added to the $4,000,000 it would cost to bring Franklin Park up to scratch and you have a $5,000,000 investment. Over a long term this would not be bad, and small admission fees and good concessions would do a lot to pay for the maintenance.

Franklin Park is owned and operated by the City of Boston. But it serves the people of Greater Boston. The City of Boston should not be blamed too much for not having made its zoo into another Bronx Zoo, for Boston's financial worries are multitudinous. It is only reasonable that the Metropolitan District Commission should take over operation of Franklin Park. The city would probably be more than happy to co-operate in this respect, and the result would be a better facility.
site. Projected service and parking areas help accommodate additional attendance and animal enclosures.

Within the last year it has been proposed that the Franklin Park Zoo be managed by the Metropolitan District Commission. In any case the idea of the zoo management being taken over by the M.D.C. is a wise and logical move, though many reasons oppose the use of Franklin Park as a future zoo site.

If the M.D.C. who now operates the small zoo in Middlesex Fells took over management of a new Boston zoo, in addition to the increased supervision, the finances of the zoo would be removed from the Boston political situation, ensuring a more steady source of available operating capital. The M.D.C., along with a Zoo Society of interested members of the community, Universities, and research groups, could handle the administrative tasks, and these same groups plus income from zoo attendance could stabilize the present financial crisis, after which a proposed zoo would have rather solid ground upon which to begin.

To date, however, all large scale plans have been only projected and the current state of the Franklin Park Zoo with minor improvements is the same as that of a few years ago — intolerable.
Typical Functional Divisions

Office Management

The size and scope of operation will determine the complexity of office organization.

Planning and Design

A successful zoological park requires the most carefully coordinated work of the architect, landscape architect, engineer and zoologist. The importance of securing competent professional assistance cannot be overestimated.

Maintenance

Maintenance and repair work may be carried on by zoological park crews but are often performed by the service departments of other governmental divisions.

Animal Acquisition and Maintenance

The director, curators and veterinarian cooperate to maintain the animal collection at a desirable level of quality and quantity.

Health and Research

The veterinarian has complete responsibility for animal health. He cares for the sick, prescribes diets and insists upon good sanitation in animal exhibits.

Public Service

Service to visitors is an important function of a zoological park. This division must be efficient and provide the visitor with services which contribute to his comfort and enjoyment.

Police

The police department must be alert at all times to give assistance and provide maximum safety for both visitors and animals.

Public Relations and Interpretive Programs

Interpretive programs and public relations designed to make visitor use more enjoyable and valuable are becoming increasingly important in good management.
DESIGN FACTORS OF A NEW ZOOLOGICAL PARK

The organization of a zoological park may be categorized in typical function divisions as described on the plate preceding this page. Of this organizational breakdown there are few categories which do not apply directly to the physical design of a zoo. The basic design elements, however, are:

1. site design
2. structural design
3. staging plan

Within the heading of site design are placed considerations as:

1. site selection
2. landscape and terrain
3. human circulation
4. location of animal structures
5. location of services for public and maintenance of animals
6. recreation and picnic areas
7. sculpture and art
8. entrance and parking facilities.

These are the elements which comprise the zoo environment.

Of prime importance in site selection are land availability and access to location. In his analysis of present day zoos, D.P. Schlegel states that "it is generally felt that a site must be conveniently located so that it is easily accessible by means of public transportation and highways. It should be centrally located but not in the center of commercial or industrial areas..." and he goes on to state that because surrounding residents take pride in the zoo real estate values increase. 4

In regard to site terrain it has been found that hilly and rolling ground can make the cost of zoo development much less of

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4 Schlegel, op. cit., p. 23.
an expense than flat land which must be artificially remodeled, and also lessen drainage problems. Surface drainage which runs off without erosion problems can also cut much cost, particularly where there is contemplation of deep dry moats. Such soil as peat, sand, and swamps may lead to serious drainage conditions. 5

It is of course desirable to preserve as much of the natural growth on the site as is feasible in development and to make use of any water the site may offer to add to the beauty of the zoo as well as for recreational purposes.

A buffer zone around the park is a necessary planning consideration as a means of obtaining seclusion from noise and other disturbance for animals and to create a relaxing atmosphere for the public recreational area.

Ample area for parking is important near enough to the park for all weather convenience and on flat enough terrain that extensive grading is not required.

A minimum of 75 acres and a practicable maximum of 200 acres has been indicated in a national zoological park survey as desirable. 6

The circulation problem brings together animal, spectator and maintenance in all combinations, with the animal-spectator and animal maintenance circulation desiring not to be intermixed and the spectator-animal and spectator-maintenance circulation desiring to become the same. The word maintenance in regard to spectators refers to those services the spectator requires in the course of his visit.

Encompassed in the heading of structural design are the problems of: 1. enclosure; 2. exhibition of animals; 3. structural stability; 4. use of materials; and 5. heating and ventilating.

"Enclosures are intended to keep animals from escaping, to protect the public and the keepers from the animals, to protect the animals

6Ibid., p. 12
from the public, (and) to provide maximum attractiveness and visibility."

There are no apparent rules as to how an enclosure should look other than to comply with the above conditions. Sanitary looking cream colored tile seems to be less prevalent now for enclosure use than in previous decades. While this increases the ease with which an enclosure may be maintained it does not appear to be as exciting a way to display animals as the more natural approach, which although somewhat more difficult to clean has the advantage of dirt not being so conspicuous.

Recent thought as to enclosure size has been to provide as much freedom of action for the animal as he may require and to keep the enclosure size scaled to the size of its inhabitants.

Until recent years the method of animal display has been by associated species. Current trends are to group specimens by size, by country or by continent, often placing together many disassociated forms which naturally tend to live among one another. When this is done the enclosure form is one of a natural habitat and one in which the spectator may almost feel a part of the enclosure by the use of concealed moats and shrubbery. In addition to moat separation, experiments have been made using low voltage electric charges, supersonic sound devices, temperature differentials and luminous intensity differences to inbound animals with varying degrees of success.

The use of materials is most important toward sustaining interest in the zoological experience. If the structure has a particularly cold or hard appearing surface the subordinate use of contrasting warm materials is vital in the portrayal of natural habitat. Materials may be thought of at the tactile level in the treatment of floors and rails.

Adequate heating and ventilation will vary with particular

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Michigan State University, East Lansing, Michigan, p. 34
species and in unusual cases may demand a completely isolated enclosure separated from the public by glass and heated to the need of the specimen. Penguins are an example of specimens needing very pure air. As long as the enclosures are lighted more strongly than the public area, one-way glass may be used in such enclosures thus decreasing nervousness in certain animals and birds due to public provocation.

Development staging is an individual problem for each situation. However, it may be said that, in order to put the zoo on an income basis as soon as possible, it should be built in increments which can be self-operating. The first stage might include exhibits not currently on exhibition at the existing zoo, thus rendering the new area a present zoo supplement. Then it could grow to accommodate the animals at the existing zoo and free the present zoo structures for other use.
SOLUTION TO THE PROBLEM

SCOPE OF THE PROBLEM

It is proposed by this problem to study the physical aspects of a new zoological park for the Metropolitan Boston Area the climatic conditions of which will directly affect the nature of enclosure. Therefore the relationship of animal, spectator and maintenance to enclosure and surroundings are of great importance in this study.

The scope of this problem is the physical design of the zoo including site selection and planning, design of enclosures and facilities, and planning of circulation and maintenance, so that the total zoo environment becomes interesting, exciting and easy to manage.

Beyond the scope of this problem are those problems of administration, finances and maintenance which do not directly pertain to the physical design of the zoo and which have been well handled by Mr. Schlegel in his zoological research.

It is my belief that the design should occur in such a way that the animals have a habitation in which they are not inhibited by the enclosure, are least obstructed from human view, yet are not subject to public torment. By means of natural texture and surroundings they should be presented in an interesting manner.
CLIMATE
THE EFFECT OF CLIMATE ON DESIGN

The factors which led to selection of site and structure were climate, animal freedom and enjoyment of visitors.

Climate, it is felt, is a most necessary and often neglected consideration in the design of existing zoos. Many zoos although theoretically open all of the year find that most attendance occurs in the three summer months of the year and drops by great margins during the remainder. This is considerably more of a problem in climates of the northern part of the United States where in addition to temperature drop the falling of snow makes getting to and going through a zoo a difficult problem. Yet this is paradoxical in that it is the time of year when schools are in session and the holiday-minded visitor is not overcrowding facilities. Thus the zoo can be of greater educational value then than in the summer.

From the financial point of view, animals must be maintained on a twelve month basis though the great amount of public income is derived from only a three-month period. Would it not be of advantage, then, to design a zoo for northern climates that would be attractive to visitors all months of the year, as some zoos in the southern U.S. are?

In the creation of such a zoo it would not be desirable to eliminate those elements of outdoor enjoyment that attract visitors to the zoo in the summer months. Many of these could be incorporated in a controlled environment during the winter which would expand to include the outdoors and additional warm weather activities during the summer.

The inconveniences of attending present northern climate zoos in months of inclement weather are many. They include the constant transition from indoors to outdoors and from building to building involving the donning and removal of apparel, the naked
and forbidding winter zoo environment accentuated by formal planning, and the possibility of viewing many empty cages due either to seasonal exhibit of the animal or his desire to remain in his shelter, often times hidden from view. Upon recent off-seasonal visit I found I was many times playing a mental game with the animal, guessing whether to view him in his indoor or outdoor enclosure. It was, I trust, due to his inconsistency rather than to my being outwitted that frequently led to the wrong choice.

If the indoor enclosures were more than a series of cages and provided the animal with as much freedom as an outdoor enclosure, there would be little need for outdoor enclosure at all in winter (provided adequate ventilation was considered). From the spectator's viewpoint this would eliminate the exasperating quiz game. Furthermore, if the enclosure was large enough to accommodate several species of animals, the spectator would be less inconvenienced by constant weather change and consequently apparel change. He would also have the opportunity, conceivably, to view animals of many species grouped together as they appear in their natural habitat - a more unusual and exciting manner in which to display animals.
Areas of Possible Zoo Location
MAJOR HIGHWAYS

EXISTING MAJOR HIGHWAYS

FUTURE MASSACHUSETTS TURNPIKE

FUTURE NORTHEAST EXPRESSWAY

OTHER FUTURE MAJOR HIGHWAYS & EXPRESSWAYS

BOSTON METROPOLITAN AREA

AS DEFINED BY 1950 FEDERAL CENSUS

SOURCE DEPARTMENT OF PUBLIC WORKS DEC 1955

Plate 4
POPULATION DENSITY 1955
PER SQUARE MILE

RANGE

UNDER 1000
1000 - 2499
2500 - 4999
5000 - 9999
10000 - 14999
15000 - OVER

BOSTON METROPOLITAN AREA
AS DEFINED BY 1950 FEDERAL CENSUS

SCALE IN MILES

SOURCE

Massachusetts Department of Commerce
Division of Planning
320 Broadway Street, Boston

Plate 5
10-foot Contour Map of Selected Site

Plate 7
THE SITE

Because the formal planning demonstrated at Franklin Park does not lend itself well to zoo activities (though it might be most exciting for other purposes); because as shown earlier in this report, I feel money for zoo expenditures could be more wisely spent than in remodeling; because the limitation of available land makes expansion which is urgently needed a difficult matter; because the lack of natural water on the site incurs added expense for needed supply, and because Franklin Park is currently under the financial hand of a City government that apparently cares not to support it, I propose the use of a new site for a new zoo.

Admittedly the convenient access to Franklin Park is a strong factor in favor of its use, but this convenience is not wasted if the Park is put to other use. The existing structures suggest the housing of inanimate forms. The formal approach and existing rose gardens indicate that a logical choice for future use would be botanical gardens. If not this, perhaps museum use or use as an outdoor amphitheatre, re-assigning the present structures for storage, rehearsal and administrative space.

Assuming then that a new site is in order, a number of areas become interesting as locations for a zoological park. Namely, Lynn Woods, the Breakheart Reservation, the Middlesex Fells Reservation, Stony Brook Reservation and Blue Hills Reservation, as shown on a preceding plate. Of note is that the latter four selections mentioned are all Reservations and thus under management of the Metropolitan District Commission. Therefore if one of these sites is chosen it will mean that finances have become divorced from local Boston politics by its selection. Lynn Woods for this reason and its relatively remote distance from central Boston was eliminated.
Of the remaining sites most are feasible. Blue Hills is particularly convenient to circumferential traffic on Route 128 as is Stony Brook, but is much further from the Metropolitan Area population center than is Middlesex Fells. The Fells area appeared to be the most conveniently and dramatically located, and thus this site where the M.D.C. now maintains a small zoo was chosen for further development.

Originally it was thought feasible to keep the zoo in its present Middlesex Fells location in the northeast corner of Spot Pond. However, Spot Pond is a reservoir as are many of the other small bodies of water in the Fells, and thus public access to them is impossible. The one portion of land which seems to offer the potential of enough land on which to place a zoo development, a body of water which is both beautiful and usable, and a combination of flat land and rolling terrain to accommodate natural enclosures, is the area of land belonging in part to the City of Medford adjoining and directly south of the Reservation, called Wrights Pond. This is 180 acres including two ponds of approximately 65 acres, rendering well over 100 acres for the zoo buildings and surrounding area.

There is no difficulty anticipated in using this land for such a purpose, for although there is a residential development south of the site, the site itself is too rocky and hilly to be used in the same way. There is a buffer zone of wooded land and hills between the zoo and the residences, and most of the zoo development is contemplated at the opposite end of the Pond from the residences. Furthermore Wrights Pond is currently being used by Medford for recreation of its residents, including swimming, boating and fishing. The zoo in fact would encourage continued use of the Pond for these activities.

The very northerly portion of the site belongs to the Metropolitan District Commission as does the land to the east and west of
the site. Presumably the M.D.C. would be the zoo developer so that expansion of facilities at a later date would not necessarily occur within the area now allocated for zoo purposes.

The land itself is hilly, rocky and quite forested, but not so much as to render development impossible. Terrain varies from areas which are quite flat to a few steep slopes and varies in contour from a 100 feet low to a 250 feet high point. Due to the consistency of wooded areas, it is impossible to see more than a small portion of the site at one time. This would make a trip through the zoo an exciting and constantly changing venture, particularly so when ambling around the lake, which is of no regular shape and would suddenly appear at a different distance from that to which the viewer had just been accustomed. Paths now exist around the site which formerly was developed in part as "Wrights Pond Park". There are stone walls enclosing part of the site and evidences of stone steps and a bridge over a stream leading from the pond.

In site development the earliest scheme (scheme I in plate following this page) had parking in the southern or lower part of the site, just off the "Fellsway" highway. The building then occurred in the upper part of the site and it was found that the major problems were that (1) the parking seemed to bear little relation to the site; and (2) the spectator upon entrance was faced with the decision whether to go out on the peninsula and across the water, or along the land next to it. In short, there was difficulty creating a major entrance. The spectator in making the loop from building to building always had to make one long walk either to his car or from it. This did not seem an adequate means of environmental control.

The next experiment shown as scheme II on the same plate put parking on the flat area just below Spot Pond and enabled the visitor to look down upon the lake from above, also providing a barrier between Wrights Pond and the Reservoir. This circulation permitted
the visitor to return more easily to his vehicle at the end of his visit. This scheme too had its drawbacks since (1) a large desirable flat area was devoted to parking; (2) there was no access to the parking from Elm Street; and (3) the buildings were still too far apart for easy wintertime control.

The scheme finally developed, scheme III, enables parking to be entered from both roads, provides a barrier between the usable site and Spot Pond, and creates a drive into the parking lot from the Fellsway which although long would be most pleasant. This would give an overall view of the site by vehicle before walking, thus permitting a rapid view at a different scale and allowing some degree of orientation. When the visitor departs from his vehicle he is greeted by two buildings close at hand for inclement weather access, goes easily from one structure to another in such weather, has the ability to pick a route to fit his desire or available time, and completes his tour at his vehicle.

The question of how to maintain and service enclosures in hilly terrain is one of utmost consideration. One does not wish to rip down trees and foliage in order to make, in addition to pedestrian paths, roads for service vehicles. One logical solution is to service the structures via the pedestrian ways, but to do so at non-pedestrian hours. The food would be delivered to each structure early in the morning, stored there and distributed throughout the day: wastes to be picked up by vehicles after closing hours.

Another way, radical and with actually less problems than one would first imagine would be to deliver and pick up wastes from just outside each structure by helicopter, whence the plane would return to a processing plant near the site, where it would be hangared and the wastes processed and sold as fertilizer. The helicopters would seldom have to land, being able to pass over slowly enough to drop food and pick up large cans of waste (though facilities for landing would be provided). With amphibian landing
apparatus deliveries could be also made by water. The only weather hindrance would be wind in which case an auxiliary land service would be in effect. In addition to outdoor feeding in the summer months, the helicopter would provide the one means by which the entire site can be seen at one time, and could maintain an accurate patrol of the area for policing and animal control purposes. It would take no more than two, or if desired, three, helicopters to do the work and substitute in case repair measures were needed on a plane. Cost wise the difference between this and vehicular service would be negligible.
THE STRUCTURE

In recent years the philosophy of zoo structures has taken two forms. One that the form and size of the structure should be relative to its inhabitants, and the other that the structure should be subordinate to the exhibition of animals and less obvious than the first method suggests.

There is much validity in both philosophies and one park need not be limited to a pure expression of one or the other. On the contrary a zoo could well be a more exciting experience if both methods of display are used. Many smaller animals better lend themselves to the "form-fitting" method, since they do not require a large area in which to roam. To give many larger animals freedom of movement similar to that of outdoor space and not to call attention to a large structural form relative to their size, it would be wise to increase the structure to a size where it would tend visually to disappear. This would also accommodate many more animals and give opportunity to include trees, foliage and other natural material in the enclosure.

Since the natural shelter an animal requires is not the same as that of man, it would be most illogical and unnecessary to limit the appearance of this to that which man is ordinarily accustomed to seeing.

The control of climate plays an important role in the structure used. One of the ways now used to display animals is by continental groups. It seems logical then that the next increment is display by climatic group, the surroundings to simulate that of native environment and the structure heated and ventilated to similar conditions.

The combination of display by continental group of a number of animals together, the concept of disappearing structure, and the
advantage of controlling environment for humans during inclement seasons led to the exploration of the dome shape. One of the early possibilities explored was the use of transparent plastic pans, which not only formed the skin of the enclosure but acted as forms for pouring reinforced concrete ribs, the final structure. During construction the plastic pans would be held in place on wooden chairs upheld on posts. The simplicity of this structure was appealing, but the practical disadvantages are many. A large number of different plastic shapes would be required in order to form each dome, the concrete would be a heavy structure and would require ribs of a four foot depth and one foot width to support a large dome, and the sensitivity of plastic would lead to many construction problems of controlling the pouring of concrete and the areas in which workmen might walk in order not to scratch the plastic.

Size and height relationships are important considerations in the architectural use of the dome as well as the number of structures required to house the zoo inhabitants. It was originally thought that three domes would be desirable, each to express a different climatic condition; a tropical, a temperate, and a cold climate dome. However, for economy reasons it would be wiser to use more domes than this, and if not all the same size, a multiple of the original size increased by lengthening the member size. A varied size would allow for animals of different size and for different numbers of animals in each group. There are many more tropical animals and less cold climate animals capable of zoo display than temperate climate animals.

The total space needed to accommodate all animals in a naturalistic enclosure is about 180,000 square feet. Three enclosures of 22,000 square feet each or 170 foot diameter, and two of 37,000 square feet each or 250 foot diameter along with passageway enclosures were found to be of sufficient size and offered ample change
of size for variety and display purposes. A desired height of one third the diameter was assumed and the geometric shape found to produce approximately that relationship was one eighth the surface of a sphere. This is identical to the shape Eero Saarinen used for the M.I.T. auditorium and, though the contemplated structure would be much different from that used by Saarinen, the shape lends itself well to rough terrain in that it rests only on three points and provides much open side wall area for a flexible ventilation system. Using this dome, the natural terrain would flow through the dome which would float above it on three level points permitting trees to grow beneath and within it.

In order to achieve a light structure approaching maximum efficiency a Geodesic structure of open-web aluminum joists was decided upon. Within this would be a rigid plastic stiffening skin. Research concluded that either acrylic or polyester plastic would be suitable for a skin material. The advantage of the acrylic would be a higher degree of transparency and luminous transmittance (91-92%), while the polyester offers a lower degree of linear expansion and has shown to be slightly more weather resistant than acrylic. Either may be used for exterior work. An inner removable skin of paper-thin mylar plastic is anticipated as a means of reducing heat loss through the shell. Pigmented, it would give more reflectivity, decreasing solar build-up, and increase interest of the structure from the exterior by giving individual color to each structure.

Heating is to be accomplished by a perimeter system of hot water fin radiation, the units of which also form enclosure bars for some animals. Return units would be in the form of sculptural shapes placed toward the center of the dome. Due to the openness of sides ventilation in summer will be easily handled. These sides may be opened for any amount of cross-ventilation.
<table>
<thead>
<tr>
<th>Property</th>
<th>Units</th>
<th>A.S.T.M. Test Method</th>
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<th>Polyester</th>
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<td></td>
<td>Cast</td>
<td>Molded</td>
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<tr>
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<tr>
<td>Stress at upper yield</td>
<td>psi</td>
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<td>Stress at fracture, &amp;*F</td>
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<td>Impact strength, ft-lb/in.</td>
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<td>Volume resistivity</td>
<td>ohm-cm</td>
<td>D257-35</td>
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<td>Dielectric constant 60 to 10⁶ c.p.s.</td>
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<td>Luminous transmittance</td>
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<tr>
<td>Haze</td>
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<td>1-2</td>
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<td>Color possibilities</td>
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<td>Thermal coefficient of expansion, linear</td>
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<td>Specific heat</td>
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<td>°F</td>
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<td>Effect of light</td>
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<tr>
<td>Heat resistance</td>
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<td>Clear resin discolors slightly</td>
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<tr>
<td>(max recommended service temperature)</td>
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<td>Clear resin discolors slightly</td>
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<td>Chemicals, effect</td>
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<td>Weak acid</td>
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<td>Strong acid</td>
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<td>Oils, aliphatic hydrocarbons</td>
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<td>Ketones and esters, aromatic hydrocarbons</td>
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<td>Alcohols</td>
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Notes:
- N.A.—Not applicable to this type of material.
- * See Table 16-2 for more detailed values.

Properties of Plastics Considered for Skin Plate 14
Due to the rather cold and manufactured appearance of these structures it is anticipated that much warm and natural material will be used in addition to the structure including stone, gravel, sand, wood, dirt, grass, brick and unfinished concrete.

It would be wrong to accommodate all animals in the dome shape just as any other one shape would not be sympathetic to all needs. Therefore, in order to accommodate those animals which are not logically housed in the domes, to create a passageway for visitors between domes, and to heighten interest throughout the visit, a secondary structural form has been introduced. This consists of a series of concrete umbrellas under which small animals are housed and through which the visitor passes. These vary in height with the size of the animal and permit light to pass between the units to the walkway beneath. In the case of monkey enclosures, the walkway is above these units and a parking area below. The umbrellas vary in size and are placed in rhythmic patterns. A removable plastic panel system from umbrella to ground would enclose the area in winter as would permanent skylites between umbrellas at roof height.

An interesting idea for dome construction came forth in the course of structural experiment. A spiral of tubular metal would be stressed on the ground and the outer ring anchored in place. A pneumatic jack and post placed under the center would then lift the structure to the desired height, the structure having an action like that of a coil spring. When raised to full height intermediate bracing would be added to insure stationary qualities. Whatever skin desired would be applied, and the pneumatic post removed. It was thought that the beauty of this was in the method of construction rather than in the structure itself and for that reason would be more applicable to building of a temporary nature than to that of zoological structures.
DEVELOPMENT STAGING

Admittedly, the program proposed here is one of long range. This, however, does not negate the validity of such a program which may well be used as a guide or master plan.

Rather than prolong the development over a period of twenty or more years, spending less per year than on a development of shorter duration, it would appear wiser to attempt to complete the development within ten years, relying upon bond issue or similar means. The lack of a short-term building plan may be a major reason for the present incomplete state of Franklin Park. Interest tends to decrease over a number of years and financing if handled on a piecemeal basis is subject to misappropriation.

The first stage includes the development of basic roads and parking facilities, the erection and subsequent enclosure development of the three small domes around the parking lot, and necessary maintenance facilities for these structures. The present recreation facilities around the park are adequate to accommodate this much of the scheme. Thus, the first stage, comprises almost half the work and would afford facilities extensive enough to attract visitors. Thus after the completion of stage one, income may be derived from the new zoo.

In the second stage the northernmost large dome, the monkey enclosures, and the terrace restaurant would be constructed along with the animal hospital. Each of the two stages described thus far would be accomplished in a three year period.

The third stage would see the final large dome and seal pool built and additions to recreation facilities made, such as a boat house and new bridges. This and the final fourth stage would be of two years each, thus completing the project ten years from its initiation. The fourth stage would bring to capacity the food and
material processing plant in an area across the Fellsway, would increase the size of the animal hospital to include a research department, and would lengthen beach area and provide more extensive picnic facilities.
Key to Number and Location of Domes

Plate 15
THE DEVELOPMENT PROGRAM

ANIMAL HABITATIONS - The following selection of location for each animal is suggested as the space he would inhabit in the final development and not necessarily that of the interim construction period.

Dome One - Africa and Asia - tropical climate
Camels - grassy flat area
Giraffes - grassy flat area with trees
Hippopotami - amphibious
Zebras - flat plains

Overhead Passage to Dome Two
Monkeys - dead trees - swings and play equipment

Dome Two - Africa and Asia - tropical climate
Apes - play equipment
Birds - trees and gravel floor

Passage to Dome Three
Outdoor Bird area

Dome Three - Africa and Asia - tropical climate
Elephants - flat plains, occasional trees
Large assorted cats - forested area
Lions - plains and grass
Tigers - forested area

Passage to Dome Four
Reptiles - individual enclosures for most species
Seals - large pond, amphibious
Small Mammals - individual enclosures for most species
Dome Four - North America and Europe - temperate climate
   Antelope - flat grassy area
   Bears - rocks and water
   Buffalo - plains
   Deer - flat forested land
   Mountain Goats - rocky hills

Passage to Dome Five
   Ducks, Geese, Swans, etc. in this portion of Wrights Pond

Dome Five - South America and Australia - temperate to tropical climate
   Kangaroos - flat plains area
   South American Pampas - flat plains area

Penguin House - glass cylinder - amphibious
   This is the principal exhibition of cold climate inhabitants

Children's Zoo and Zoo Farm Combination
   This is an exterior summertime feature and includes animals and animal cubs of the above mentioned species. In addition, farm animals from the local area may be imported for seasonal exhibit. The development is playful and may be of fantasy character

AUXILIARY FACILITIES

VISITOR APPROACHES
   Entrances - located at each major road
   Bus Stations - at Fellsway entrance for local buses and near parking area for special zoo buses
   Parking Facilities - parking for over 1100 cars at 300 square feet per car in addition to parking outside park for special zoo buses
Question House — located near parking lot for visitor information service, guide and animal books, film and souvenirs

Visitor Facilities within Park Development
Restaurant — indoor and outdoor lunchroom dining
Refectories — located near picnic areas for sale of supplementary picnic food, and throughout park for light refreshment
Toilet Facilities — conveniently located throughout
First Aid Station — centrally located near parking area
Zoological Society Building — between Domes Two and Three, containing administrative offices (private) and a small zoological library, museum, and auditorium seating about 250 persons
Boat House — at north end of southeast beach area for paddle-craft rental
Observation points and picnic-recreation areas are located throughout and along east side of site respectively

Service Facilities
Animal Maintenance Buildings — during construction, located convenient to Domes, one maintenance building to serve two or three Domes. After completion, located across Fellsway and centralized as a building complex, including food storage, waste processing and concession storage buildings, and garage.
Power House - located within park near Fellsway entrance at end of service court
Animal Hospital - at Fellsway service court overlooking Wrights Pond, including facilities for animal rest, surgery, observation, and research.
Photographs showing:

(1) Typical Structure Found in Many Zoos
    (Elephant House, N.Y. Zoological Park)

(2) & (3) Contemporary Method of Outdoor Display
to be Incorporated also in Indoor Display.
Many animals roaming area together separated from one another by natural barriers
    (African Plains, N.Y. Zoological Park)
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THE Middlesex Zoo was founded in 1905 by Mr. Charles Price, who at that time was superintendent of the Middlesex Fells Division. The first animals in the Zoo were those native to the Middlesex Fells wooded reservation—foxes, rabbits, muskrats, skunks, raccoons, crows, hawks, ring-necked pheasants, and squirrels. As the Zoo increased in popularity during the early years, other animals, such as peacocks, peafowls, snakes, were added.

Today a wide variety of species from all over the world inhabit the Zoo. Here you will find deer, elk, buffalo, wild pigs, goats, seals, emus, llamas, Brahman cows, aoudad, tahrs, porcupines, mink, black swan, coati-mundis, himalayan bear, wild cats, fancy birds, turtles, gold fish, ponies, chimpanzee, sheep, arctic foxes, owls, anteater, monkeys.

As often as possible new animals are added to the collection by exchange, breeding or gifts. Animal babies born to the Zoo are traded to other animal collectors for some species new to the Zoo. It is by this method that the collection has grown. However, since most wild animals will not breed in captivity, exchange possibilities are somewhat limited.

Gifts account for many of the animals seen in the Zoo, particularly the more common species. Every year alligators are donated by people wintering in Florida. In the spring many new rabbits are received. During severe snow storms, the Zoo is a haven to snow white owls driven south by storms and rescued by thoughtful citizens.

Much of the green feed for the animals is raised right in the garden adjoining the Zoo. Milk is delivered every day from a dairy. Fresh horse-meat for the lions, cougar, leopard and tigers and fruit for the monkeys also are on the daily grocery list.

Often described as “the most compact zoo in the world”, the Middlesex Zoo is the only state-owned Zoo in Massachusetts. Proof of its popularity and the fine purpose it serves is that as many as 10,000 people visit it on a single Sunday and during the week days the average attendance is four to five thousand in pleasant weather.
Legend

1. PEAFOWLS
2. MONKEYS
3. JAGUAR
4. LEOPARD
5. TIGER
6. LIONS
7. LIONS
8. PARAKEETS
9. CELANESE DONKEY
10. SHEEP
11. BLACK BEARS
12. PECCARY
13. GOATS
14. BISON
15. DEER
16. SHEEP
17. TURTLES
18. CHIMPANZEE
19. COATI MUNDI
19A. ARCTIC FOX
20. DUCKS
21. ALLIGATORS
22. GUINEA HENS
23. CRANES
24. PIKIN DUCKS
25. GOLDEN PHEASANT
26. BANTAM HENS
27. BRONZE PHEASANT
28. HENS
29. LADY AMHERST PHEASANT
30. SILVER PHEASANT
31. FANCY HENS
32. PHEASANTS
33. PORCUPINE
34. WHITE FOX
35. RABBITS
36. Doves
36A. OWLS
37. BLACK BEAR CUB
38. COUGAR
39. BADGER
40. BLACK RACCOON
41. GREAT HORNED OWL
42. MACAW
43. SNOWY OWL
44. HIMALAYAN BEAR
45. BEAVER
46. WOODCHUCK
47. RACCOONS
48. SQUIRRELS
49. BLACK FOX
50. RED FOX
51. PIGS
52. VULTURES
53. EMU
54. GOAT
55. RABBITS
56. DUCKS
57. SKUNK
58. BLACK SHEEP
59. SHEEP
60. PIG
61. CATS
62. GUINEA PIgs
63. PIGEONS
64. DUCKS
65. NOAH'S ARK
66. DEER
67. RUSSIAN BEAR
68. BLACK BEAR
69. CINNAMON BEAR
70. RACCOONS
71. COYOTE
72. BRAHMA COW
73. LLAMA
74. TAHR
75. ELK
76. MOUNTAIN GoATS
77. DUCKS, GEESE
78. TURKEYS
79. BARN
80. REFRESHMENT STAND
81. HOUSE
82. OFFICE
83. LADIES REST ROOMS
84. MENS REST ROOMS
85. PUBLIC TELEPHONE

Map of MIDDLESEX ZOO