

# FORTY TONS OF CORAL

by

ROY WALDO MINER

CURATOR OF LIVING INVERTEBRATES, AMERICAN MUSEUM



*Reprinted from Natural History Magazine  
for July-August, 1931*

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THE AMERICAN MUSEUM OF NATURAL HISTORY  
NEW YORK, 1933



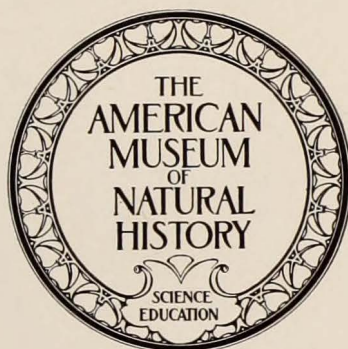
OF THE  
AMERICAN  
HISTORICAL SOCIETY

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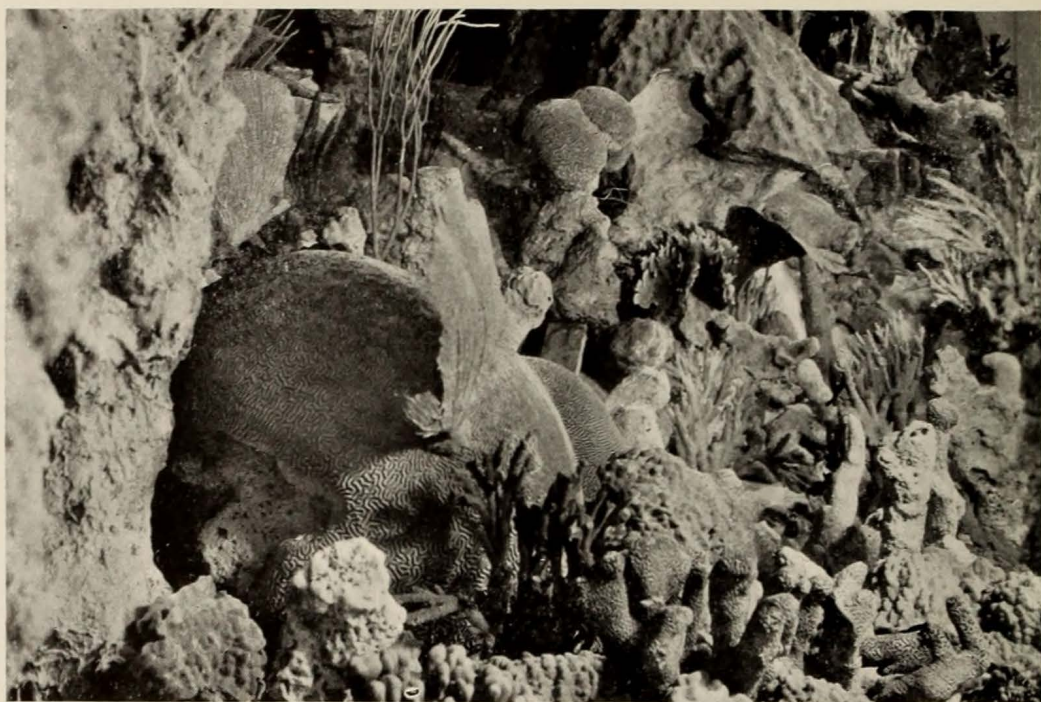


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Fantastic Growths of Coral in Weird Formations Crowd the Sea Bottom

## FORTY TONS OF CORAL

The Story of the Preparation of the Immense Coral Reef Exhibit Now Under Construction in the New Hall of Ocean Life at the American Museum

BY ROY WALDO MINER

Curator of Living Invertebrates, American Museum

**F**ORTY tons of coral trees growing on the ocean floor, bathed in the crystal waters of tropic seas, three fathoms below the surface, amid waving sea plumes and schools of brilliantly colored fishes flitting between their branches!

Forty tones of coral ripped from the heart of a hundred-mile submarine forest of tinted limestone, hauled to a snowy beach, bleached, embedded in sponge clippings, packed in huge crates, and shipped to the American Museum!

Forty tons of coral rising from the floor of the Hall of Ocean Life, their serrated branches interlaced as of old and once more invested with the delicate hues that gave them their pristine beauty, while above them again spreads the mirroring quicksilver of a simulated watery surface overarched by the blue of a painted tropic sky!

Such, in brief, is the story of the great Bahaman Coral Reef Group which, for several years past, gradually but steadily, has been approaching realization in the largest and most imposing of the Museum's exhibition halls. The expeditions which secured the specimens and other data for the group, replete with romance and adventure, have been described in previous issues of *NATURAL HISTORY*. It is not my purpose in this article to repeat these incidents in detail, but, though the exhibit, which is their fruit, is not yet completed, it may be of interest to summarize briefly the chief events of these voyages and then to recount the principal steps in the actual building of the group itself, an undertaking of unusual magnitude.

The idea of building a replica of a Bahaman coral reef had been in my mind



for a number of years, but first took definite shape during the year 1922 when the steel structure for the new Hall of Ocean Life was in process of erection and I was informed by President Osborn that the department of lower invertebrates was to have an important share in the exhibits to be housed in it. At the same time he requested me to submit suggestions for an invertebrate exhibit of outstanding character which also should be typical of oceanic life.

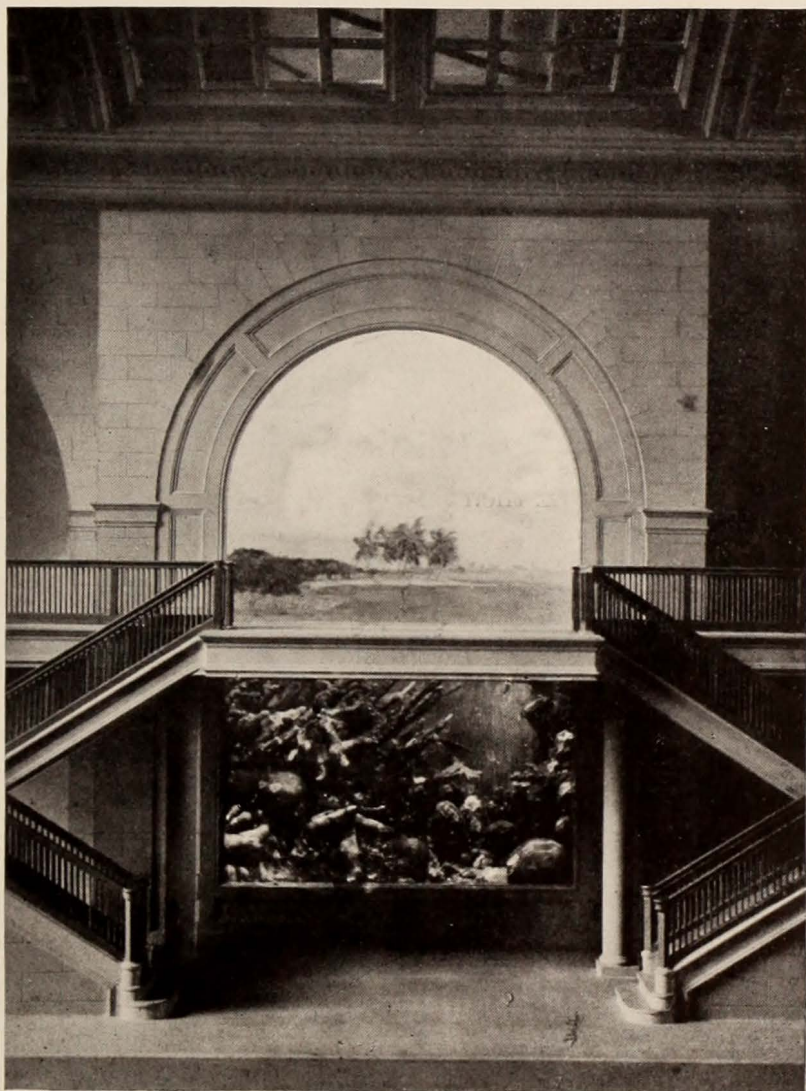
The reef-building coral polyp with its associates, has probably produced the most significant and conspicuous results of all the lower inhabitants of the seas. Its castellated structures of limestone may rise from depths of twenty or thirty fathoms to the ocean surface, and, in the case of the Great Barrier Reef of Australia, extend for more than fourteen hundred miles in length. They are dotted over tropic seas where they are perilous to vessels approaching them from without, while the difficult entrances through their submerged barrier walls, when mastered, lead to harbors of safety. Hence, they must be accurately mapped on navigators' charts. As world-builders, the coral and its associates

have taken part in the construction of many oceanic islands forming the abode of men, and during past geologic ages, were an important source of the continental limestone deposits of the world.

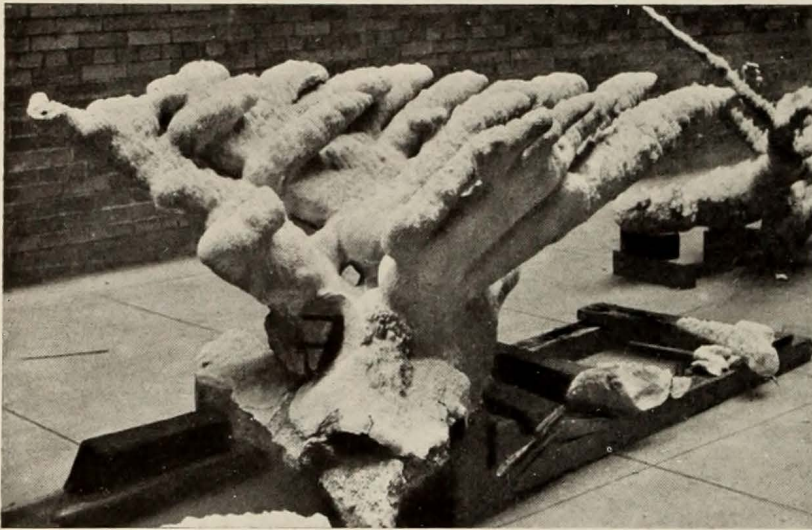
It was natural that I should jump at the opportunity of building a coral reef exhibit for the new hall, and so, under my direction, Chris E. Olsen, modeler in my department, prepared a scale model of a proposed installation for the new group adapted to the architecture of the hall and embodying my ideas for the exhibit. This was presented to the President and Board of Trustees early in 1923 and was unanimously accepted by them, and I was authorized to prepare plans and to make negotiations for

#### SKETCH MODEL OF THE CORAL REEF GROUP

Designed by Doctor Miner and modeled by Chris Olsen on the scale of  $\frac{3}{4}$  inch to the foot. The model represents the central portion of the western end of the Hall of Ocean Life, showing a representation of the proposed coral reef group in position







PALMATE CORAL WITH BEAM-SHAPED BRANCHES

A characteristic growth of coral under exposed condition near the surface of the sea. This ten-foot specimen was collected by B. E. Dahlgren and Herman Mueller from the Andros Reef in 1908, and was brought to New York by Joshua Slocum in his famous sloop "Spray," in which he had just returned from his remarkable voyage around the world

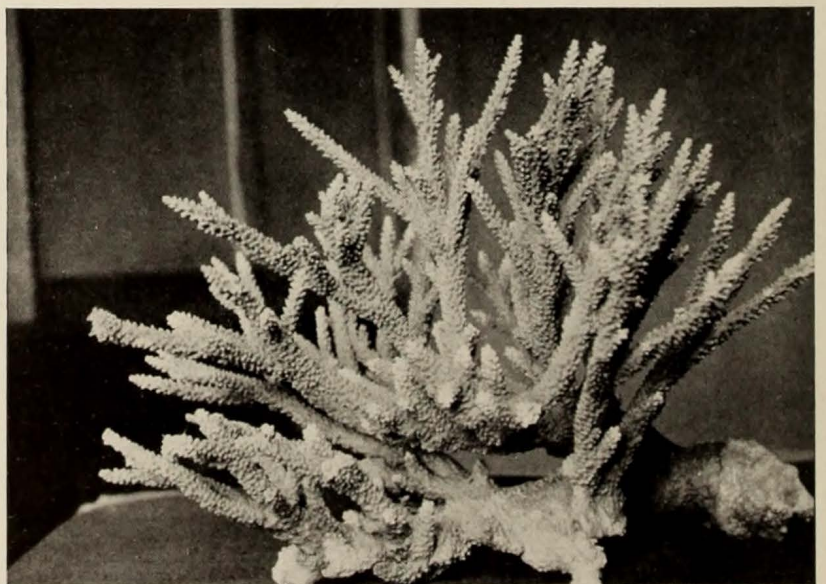
the necessary expeditionary work.

Four expeditions to the Island of Andros in the Bahamas were undertaken in the interests of the group between the years 1923 and 1930. The first, in December, 1923, was of a preliminary and exploratory character, in which I made arrangements for the first main trip which took place during the summer of 1924.

Early in June, I arrived in Nassau, accompanied by three artists and modelers of the American Museum staff: Messrs. Herman Mueller, Chris Olsen, and Dr. George H. Childs of the department of lower invertebrates. We allied ourselves there with Mr. J. Ernest Wil-

#### FAN CORAL

This fragile variety (*Acropora muricata* var. *prolifera*) often is found clustering thickly on the floor of the sea outside the great forests of elkhorn, in strangely exposed positions without danger to its fairy-like beauty



liamson, who generously put himself and his wonderful under-sea tube at our disposal, and with the cordial coöperation of the Bahaman Government we set sail for Andros.

Here, skirting the eastern shore for more than one hundred miles, is the finest coral barrier reef in the West Indies, and here, seated in the spherical steel submarine chamber of the tube, we gazed out through a plate glass window at a magnificent submarine forest

towering above us everywhere. We made water-color sketches, instantaneous photographs and motion pictures through water so transparent that we could see one hundred and fifty feet through the weird tangle of sea growths before our vision was obscured by the luminous, pearly blue fog beyond.

Aided by diving helmets and a chain hoist mounted on pontoons, we attached chain or rope slings to the coral masses



we desired, and dragged them to the surface. Our largest specimen weighed two tons and was twelve feet in length. We towed our catches to the sheltered beach of our little Cay and there we bleached them. This process consists in keeping the surface of the corals wet until the thin outer layer of animal tissue decays and sloughs off, leaving the white limestone skeleton exposed.

When we had completely covered the beach with gnarled and twisted branches of elk-horns, spike-like tangles of stag-horns and the delicate and fragile clusters of fan corals standing out among dome-shaped specimens of orb and brain corals, we sent natives to Nassau to bring us boatloads of heavy pine timber, from which we constructed crates and packed our specimens in them, embedded in sponge clippings. These were finally shipped safely to New York.

The third expedition was devoted to



PALMATE ELKHORN CORAL

This beautifully symmetrical specimen (*Acropora muricata* var. *palmata*) grow in a sheltered position, so that its branches spread out evenly in broad fronds, contrasting sharply with the twelve-foot specimen shown on page 378 which grew in an exposed position on the outer reef, in which case the most rapid growth is with the direction of the prevailing oceanic currents

obtaining the reef fishes for the group. It was conducted with the coöperation of Mr. John S. Phipps, who lent us his fine houseboat yacht, "Seminole," and several smaller motor boats. The sea-going motor launch, "Iolanthe," was also with us during part of the time. Mr. Phipps' son, John H. Phipps, accompanied the expedition, and was in general charge of the fleet. Mr. Phipps, Senior, and several members of his family and

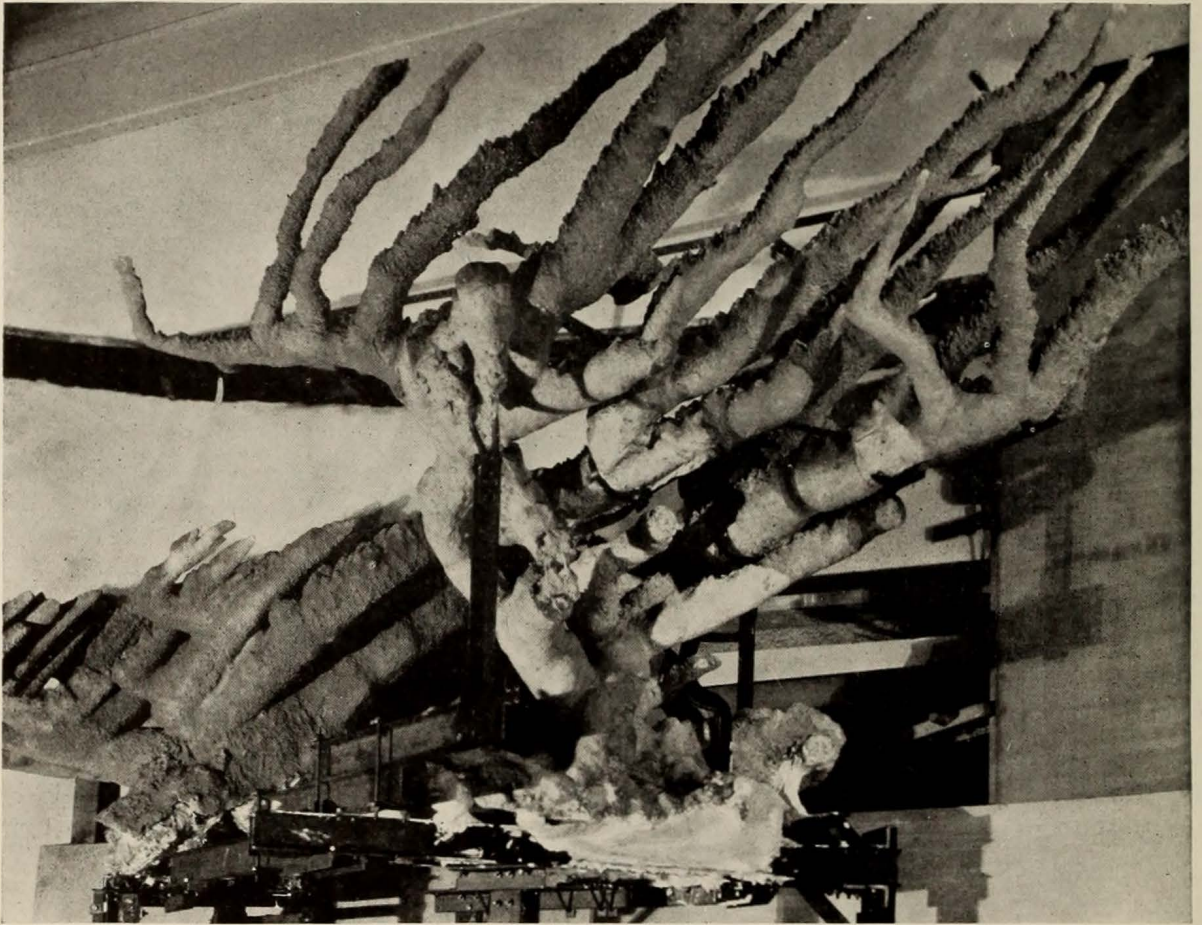
guests visited us while at work. I was accompanied by my wife, son, Roy W. Miner, Jr., Chris Olsen of the Museum modeling staff, and Mr. J. L. Jaques, Museum artist. We were on the Andros Reefs from the latter part of June until

FINGER CORAL

This species (*Porites clavaria*) grows so prolifically that it sometimes rises in dome-shaped colonies thirty feet in diameter. The finger-shaped branches are closely set. A detail of the Coral Reef Group







THE TWO-TON CORAL SPECIMEN IN PLACE

This immense coral tree rises from a contorted cluster of trunks and now dominates the entire summit of the stony forest forming the center of the group. This specimen, with branches spreading twelve feet horizontally, was torn from the sea bottom in front of the coral barrier reef at Andros

the end of July. We set fish traps among the reefs, and used granges, gill nets, hand nets, and hook and line to obtain our specimens.

As soon as the fish were caught, living specimens were placed in aquaria and sketched in colors by Mr. Jaques before their brilliant hues faded. These and other specimens then passed through the hands of Mr. Olsen and my son who constructed plaster molds from them, and the specimens themselves were preserved in alcohol and formaldehyde for future reference.

In this way we secured molds and sketches of sixty-five different species of typical reef fishes. Later on, wax casts will be constructed from these molds, which, colored from the data furnished

by Mr. Jaques' accurate sketches, will bring to life once more in the Museum group the multitudinous gaily colored fish population of the Andros Reef. During this expedition, Mr. Jaques made sketches for the cyclorama to form the great above-water background of the future group.

During our stay we experienced a severe hurricane but came through without damage to ourselves or our collections, and reached New York just in time to escape the second hurricane of that year which wrought such havoc in Miami.

The fourth trip was undertaken during the early spring of 1930, when Mrs. Miner again shared my experiences with me. We spent the month of March as





#### MAKING THE SKETCH-MODEL FOR THE CORAL REEF GROUP

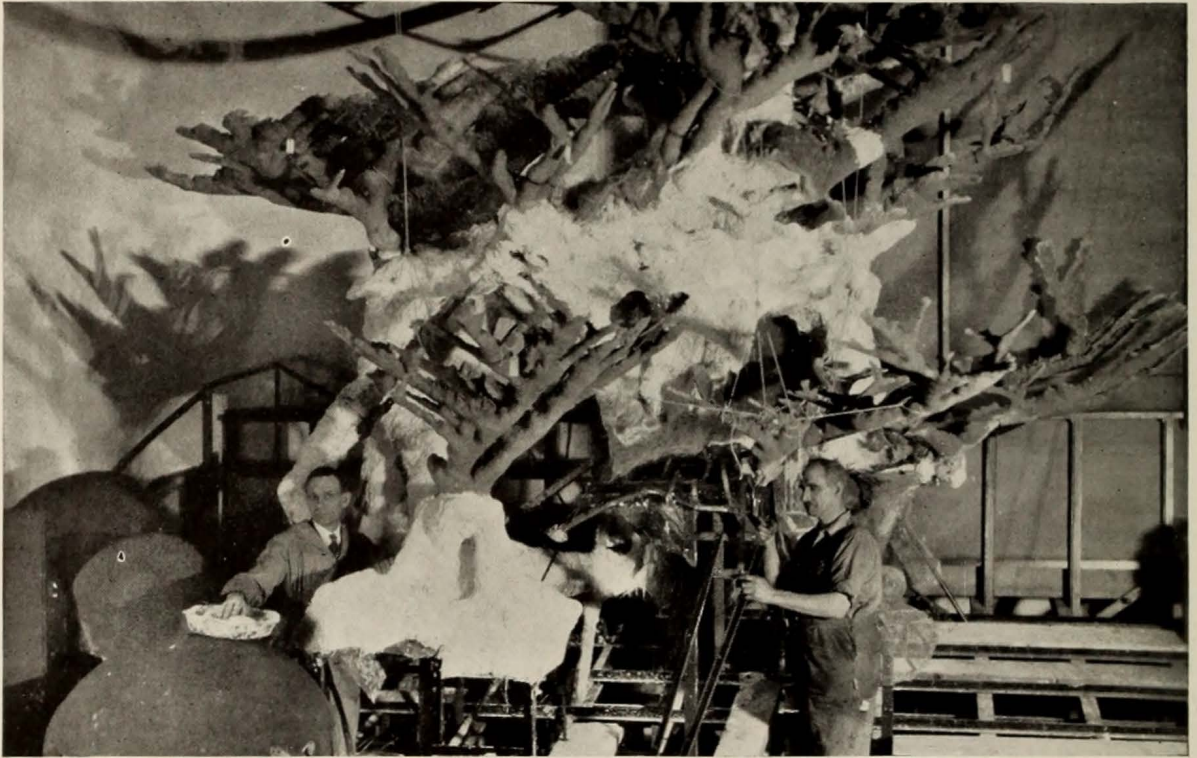
Chris Olsen is modeling the coral specimens in miniature under Doctor Miner's direction. They are placed in their correct position in the model; measurements are taken with reference to fixed points; and then the massive corals of the real exhibit are hoisted into exactly corresponding positions guided by similar measurements in the large group



#### LOOKING OVER A PART OF THE FORTY TONS OF CORAL

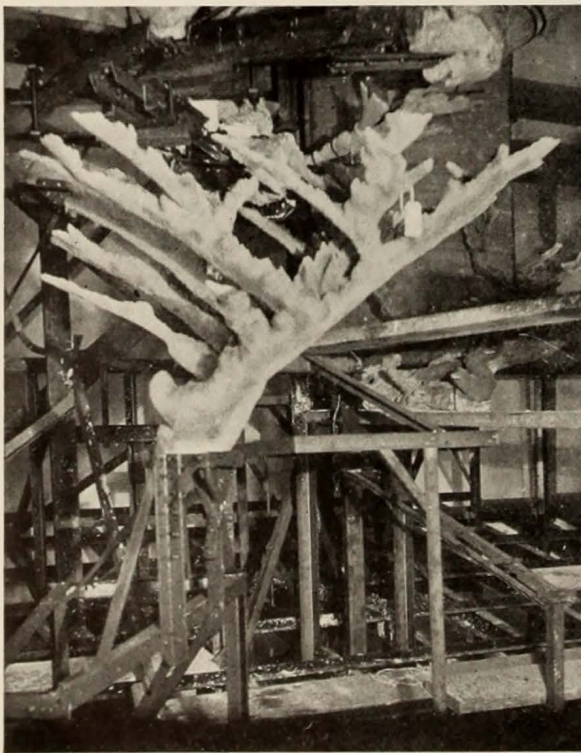
It took six months to clean the specimens in preparation for coloring. Those shown here have received a thin coating of wax, colored to simulate the living animal tissue covering the corals in life





#### MODELING "DEAD CORAL" ARCHES OVER STEEL WORK

Plaster of Paris over wire screening is used for this purpose. Later on a thin coating of beeswax and oil colors gives the surface effect of the natural formations as they appear on the sea bottom. The steel worker is constructing steel supports



#### ELKHORN CORAL

This unusually perfect specimen shows the typical method of branching

guests of Mr. and Mrs. Daniel Bacon on their interesting island camp, "Pirates' Nest." Through their courtesy, we established our headquarters here while gathering and preparing sea plumes and sea bushes for the new group.

Later on, we were joined in Nassau by Dr. and Mrs. Charles J. Fish, of the Buffalo Museum of Science, and with them explored the beautiful coral reef at Rose Island. This work was greatly facilitated by Mr. Hugh Matheson, of Coconut Grove, who put his ketch, the "Marmion," at our disposal. Utilizing diving helmets, we descended to the base of the reef at a depth of three fathoms, and made many observations and motion pictures of great value for the group.

So much for the field work. Difficult and arduous as it often is, and beset with unexpected and unusual problems, the work in the field is nevertheless the most romantic and enjoyable stage in the

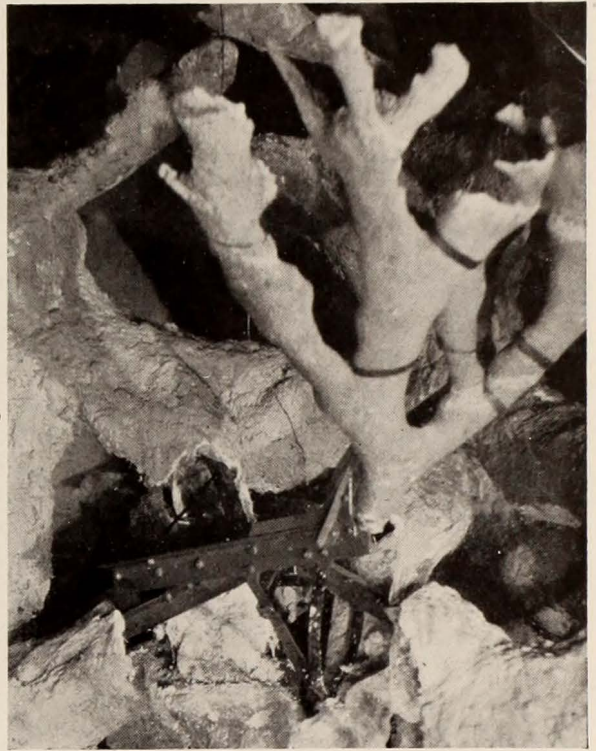


preparation of Museum groups. More than this, however, it is absolutely essential for the production of museum groups conceived in the modern spirit.

The ideal museum group is not merely a work of art. It is a record of living beings in their natural state and environment, depicted in their proper relations to their surroundings, and emphasizing the truth that the real unit in nature is the association rather than the individual.

To make these groups accurate portrayals of reality, the modern Museum finds it necessary to send out well equipped expeditions to all parts of the world to gather the facts of nature at first hand. Consequently, if it is desired to build a group which will faithfully depict the life of the sea bottom, one must descend to the bottom of the sea to obtain the material and the observations to make this possible.

The preparation of the group in the

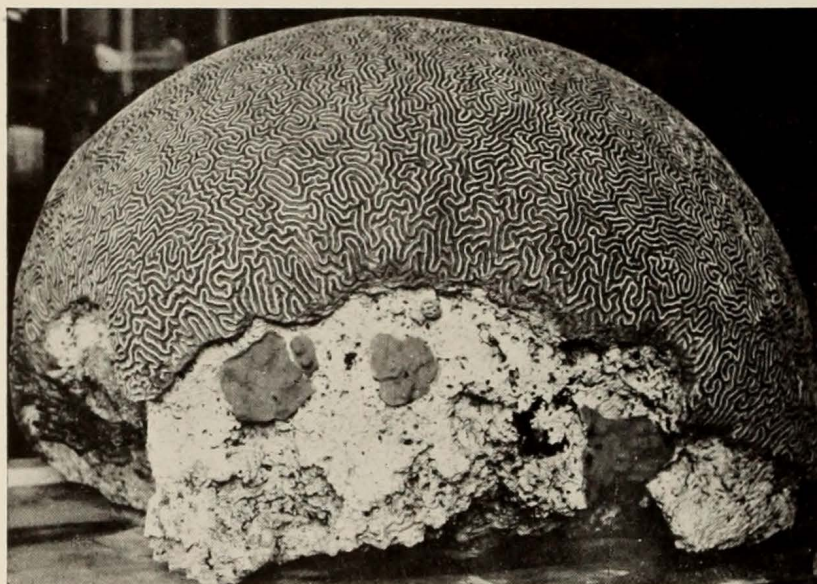


A DETAIL OF THE GROUP  
Showing the steel framework anchoring a specimen of elkhorn coral in position



BRAIN CORALS GROWING AT THE BASE OF DEAD CORAL BEAMS  
Welded together by overgrowths of *Lithothamnion*, a calcareous alga, or sea plant, which encrusts the dead coral with an overlying blanket of additional limestone, thus adding materially to the bulk of the reef





A LARGE HEAD OF BRAIN CORAL (*Mæandra cerebriformis*)  
Showing the intricate pattern produced on the surface of the coral  
limestone built up by the rapidly dividing coral polyps

Museum, while not so romantic as the field work, nevertheless is full of interest and is beset with fascinating problems. Often these present special difficulties involving original and unprecedented methods, which, however, give greater zest to the work. This has been especially true of the Coral Reef Group.

In order better to understand our aims, let us first try to visualize the exhibit as it will appear when finished. We pass through the archway leading to the Hall of Ocean Life and find ourselves standing on the gallery surrounding an enormous hall 160 feet long and 130 feet wide. The lofty ceiling is surrounded by skylights and springs from a series of arches enclosing lunettes. These form the settings for murals depicting on one side of the hall various species of whales in their oceanic environment, and on the other, scenes illustrating the capture of whales by the old-fashioned whaling ship of by-gone days. Skeletons and models of whales are suspended from the ceiling. An extensive shell collection occupies the gallery, and beneath it are caught glimpses of a series of pictorial groups illustrating the life of walruses, sea ele-

phants, seals, and other marine mammals.

These features become apparent as the visitor has time to examine the hall in detail, but what first strikes his attention and holds his eye as he enters the hall is the enormous, brilliantly lighted group immediately facing him at the farther end.

The exhibit is framed in a great arch rising from the floor of the hall sixteen feet below the gallery and, passing through the latter, it

sweeps in an enormous half-circle thirty-five feet above the main floor. Apparently one looks through the portion of the arch above the gallery into a tropical lagoon overarched by a brilliant sapphire sky with towering trade-wind clouds

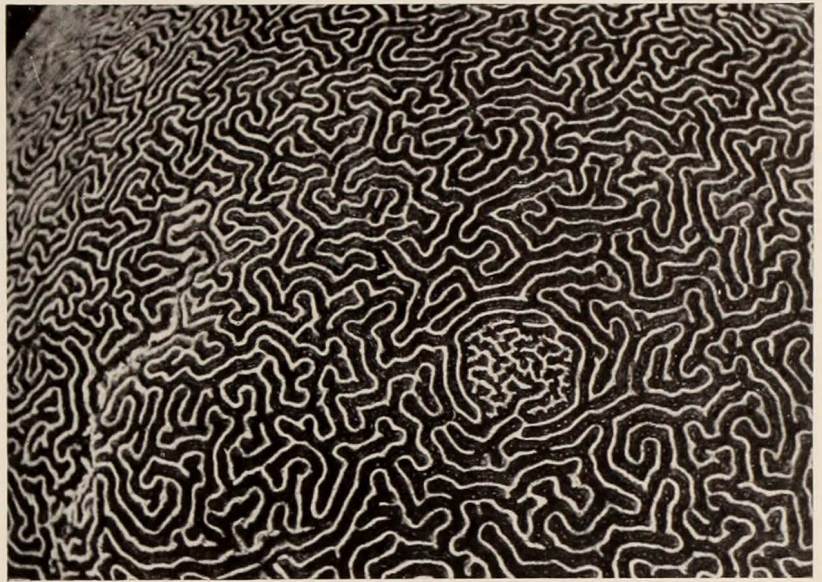


TOUCHING UP THE MENDED BRANCHES  
Doctor Childs is skilfully repairing an elkhorn  
coral specimen that was broken in transit



drifting by. In the foreground is a cay overgrown with shrubbery and plumed with wind-blown coconuts. In the distance is the long, low-lying shore of Andros.

We walk around the gallery and approach the arch from the right. The half-domed cyclorama, the masterpiece of F. L. Jaques, depicting the scene, discloses a new vista with every step. Now, we are looking out across the coral barrier marked by long lines of gleaming white breakers at the dark-blue, deep waters of the Tongue of the Ocean. As we come nearer, the emerald green shallows just within the reef meet our view, intersected with long, arching lines of rippling wavelets



A "CLOSE-UP" VIEW OF BRAIN CORAL  
Showing a remarkable labyrinthine growth around an enclosed nodule of more closely contorted pattern

caused by the surges dying out over the obstructing barrier.

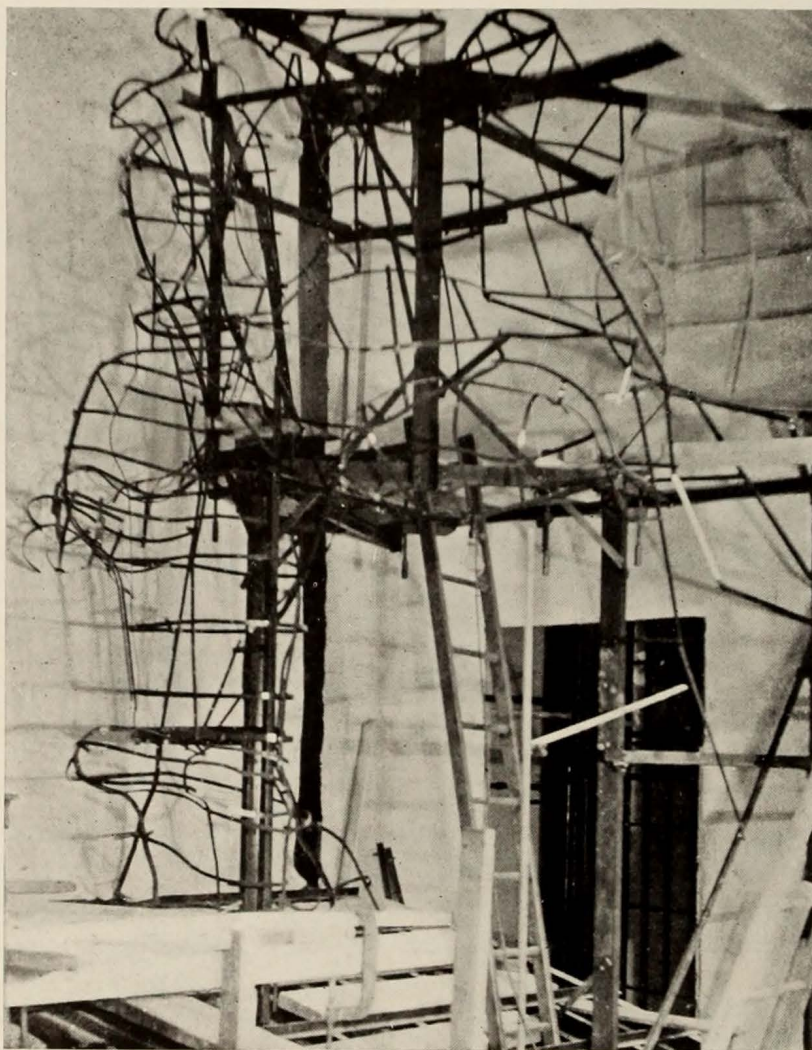
As we face the arch, turquoise and green slicks of quiet waters spread out beyond the white, sandy point on the inner side of the cay, mirroring in the distance the alternating clouds and luminous sky colors along the horizon. Overhead, a long line of roseate flamingos sails above the palm trees, the birds lazily and majestically flapping their black-bordered wings as they follow the direction of the wind toward Middle Bight, an inland sea piercing the distant land-mass with its quiet waters.

Glancing downward, we see that the foreground is of transparent glass simulating the water surface, through which penetrate the tips of submerged elk-horn corals. We are looking into the heart of a coral reef, the treelike growths giving us glimpses of a fairy world between their branches. Our curiosity whetted, we note there are descending staircases on either hand. Down one of these we pass beneath the gallery and find ourselves looking through a coral forest, the tangled branches of which rise above our heads. We are standing on the floor of the sea!



COLORING A HEAD OF ORBICELLA CORAL  
Chris Olsen is not only an expert modeler but also an artist of unusual attainments





THE STEEL FRAMEWORK OF THE "CORAL CAVE"

The heavier channel irons form the main structure and the lighter framework gives shape to the outline of the submerged coral cliffs, shown in nearly completed condition on the opposite page

I shall leave a further description of this weird and strangely beautiful world until the group has reached its completion. At the present time we are still struggling with the problems of partial accomplishment, and our imagination has filled in the unfinished details, as we are continually doing in the actual process of preparing the group. Let us now review some of the steps which have brought it to its present stage of preparation.

Let us imagine we have just returned from the expedition of 1924. Our forty tons of coral have arrived. In the courtyard outside the Hall of Ocean Life are thirty-one huge cases of hard pine. Our

men carefully remove the planks from the tops of the cases, and disclose the soft masses of closely packed sponge clippings in which our corals are imbedded. Each case contains a large specimen blocked and braced in its center, while around it the lighter and more fragile specimens are closely packed, separated from one another by the elastic cushion of the sponges. As the specimens are laid out in long rows in the courtyard, we are delighted to find that but very few of them are broken after their long voyage of a thousand miles over a rough sea.

After all are unpacked, the next step is to clean the specimens thoroughly. There are so many of them, and they are frequently so complicated in their

branching structure, that it takes six months of industrious work to accomplish this process properly.

Next, each specimen is coated with a thin layer of beeswax to simulate the animal layer, which in life invests the coral. This also serves to fill and seal the minute crevices with which coral is permeated, thus keeping the crumbling limestone dust within and furnishing a proper surface substance for coloring.

Now, each specimen is colored with oil colors, following sketches made from life. Each species has its appropriate color combinations and it is necessary that they should be faithfully represented to give



a lifelike appearance. Some of the brain corals are peculiarly difficult, for three main colors are involved, one of which, a green hue, must be applied in the bottom of the sinuous winding valleys with which the huge heads are covered in a most complicated pattern.

Some of the delicate fan corals were quite broken, and these had to be mended. All the broken tips had to be saved and carefully matched to their proper stumps, drilled and pegged with wire pegs, cemented with litharge, and the joints colored so that they could not be detected when finished. This was accomplished most successfully, Doctor Childs and Bruce Brunner showing an especial aptitude for this work, while the coloring by Mr. Olsen and Mr. W. H. Southwick is remarkably true to nature.

Meanwhile, Olsen busied himself in constructing miniature models of each essential coral mass on the scale of three-fourths of an inch to a foot, and these were built up into a miniature composition according to the design which I had projected. This gave us a working model. Fixed points were designed upon this model and corresponding points were plotted in the great space 30×16×16 feet which the grup was destined to occupy.

A skilled iron-worker was assigned to our work, and began erecting a sloping steel framework in the form of a grid,



LOOKING INTO THE HEART OF THE CORAL CAVE

A detail of the group in an advanced state of completion. The cave shows in the center of the picture, its entrance overarched by a projecting shelf of sage green brain coral (*Mæandra*)

to hold our heavy but fragile corals.

The largest coral masses were suspended by powerful chain-hoists in their proper places above this, using the sketch-model strictly as a guide. Each was carefully adjusted in a lifelike position, with due regard to the growth of each branch as determined by the prevailing oceanic currents, and then the steel structure was built up to support it properly, each piece, whether I-beam, channel iron, or T-iron, being carefully cut to fit.

It was always a case of try and cut and try again, bending and fitting according to need, remembering always the over-





#### PREPARING THE HUGE TWELVE-FOOT SPECIMEN

The artists are mending and touching up the coral branches, while the iron worker is working with an electric drill on the supporting steel armature

hangs and caverns planned in the composition of the group, and yet compensating by braces judiciously placed according to need, or concealed rods bolted into the floor to act as check reins with turn-buckles adjusted to give the right tension.

This was a steel structure which no blue-print could map out beforehand and required the most continuous impromptu exercise of engineering ability and adaptable ingenuity, qualities for which Louis Beauvais has shown especial capacity during the three years in which he has been patiently fitting six tons of steel parts into this group with which to

support our forty tons of coral in its proper anchorage.

Early in the construction of this part of the work two huge sheets of plate glass were raised into place to serve finally as translucent backgrounds. One of these is eleven feet in height and the two are together so contrived as to form a continuous backing for the group. On these finally will be painted a continuation of the submarine vista. A great curving opaque background behind them will depict the still more distant prospect. This will be illuminated by soft, concealed lights which, shining through the translucent screen in front, will give the soft, watery effect of the under-sea. Chris Olsen has been painting many studies of submarine

effects most successfully in preparation for coloring these backgrounds.

The principal mass of coral trees rises in the left center of the foreground, the steel supports completely concealed by modeling representing eroded masses of dead coral branches forming arches and caverns.

To the right of the group a great cavern of eroded and welded limestone and coral has been modelled. This reaches the surface to form a cay of grotesquely eroded rock awash at low tide. These features have been modeled over the iron framework by Mr. Olsen, using first a base of stiff wire screening,



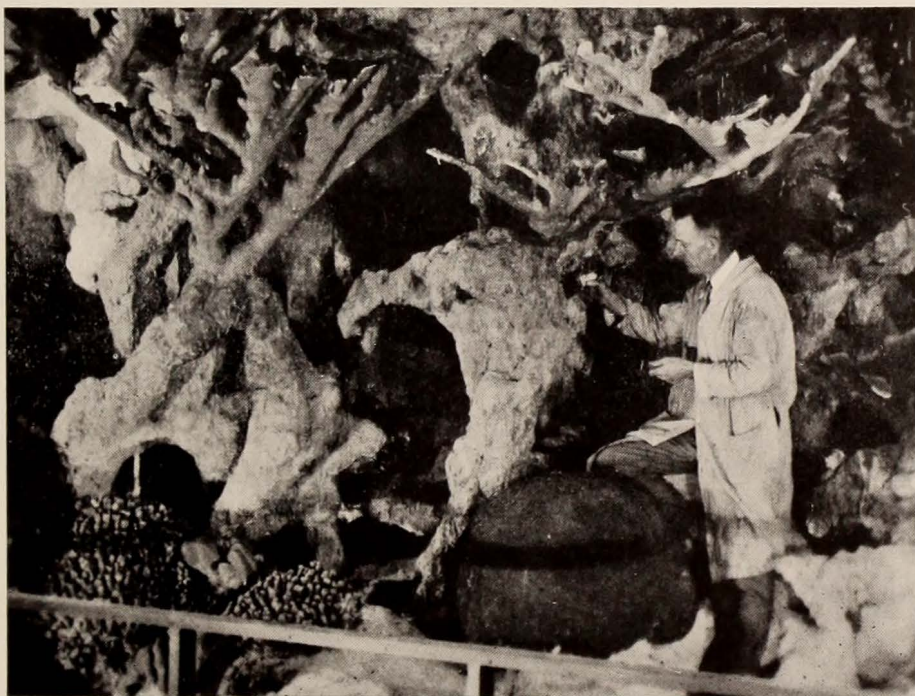
over which is spread plaster of Paris mixed with excelsior, forming a rigid matrix. Over this, in turn, is brushed a layer of bees' wax to form a finished surface, and finally the whole is colored with oil colors to represent dead coral limestone, coated with encrusting algæ, bryozoa, sponges, and other living forms of beautiful color tones, as in the actual reef.

Thousands of smaller and more delicate corals have been colored to be inserted at the proper time. Hundreds of sea fans, sea plumes, sea bushes, and sea whips have been prepared by special processes and colored, ready for placing. Our skillful glass-modeler, Herman Mueller, is constructing fragile glass polyps and other organisms for assembling in the foreground. Olsen is coloring, modeling, and assembling assorted varieties of details, and is devoting his ingenuity to the solution of all kinds of problems. Great sheets of rippled glass have been prepared, and a complex yet unobtrusive structure has been contrived to support them in such fashion as to simulate the water surface.

A carefully worked out system of light boxes with special illuminating units of daylight lamps is being installed, and two immense glass fronts are being ordered to enclose and protect the group both above and below the gallery.

Within the coral forest beneath the crystal water-surface, hundreds of reef fishes of all the typical species will be seen disporting themselves between the branches or darting in and out of the coral arches and caverns. These, as above mentioned, will be cast in wax, from the plaster molds made from actual fishes in the field, and colored to the verisimilitude of life.

Finally, it is hoped that the group, when finished, will create in the visitor the illusion that he has actually descended beneath the tropic seas—that, without leaving the metropolis, he has been able to witness a world of life that would otherwise require long voyages, special equipment, and the willingness to don diving helmet and leaden weights in order to lower himself into Davy Jones's Locker!



Coating the coral surface with melted beeswax











