

various improvements are completed, irrespective of the Bronx River. About the museum 25 acres of land have been reserved for ornamental purposes. South of the museum is a glade devoted to the systematic display of a collection of herbaceous plants. It is a meadow intersected by a stream and bordered by trees.

In this space provision is made for hillside plants and those which thrive best in the shadow of woodlands. Upward of 5,000 plants have been set out and labeled, and already the plantations afford a valuable opportunity for study. The Pinetum west of the herbaceous grounds has been stocked with many fine specimens of pines, firs, spruces, and larches.

The museum building is at present the most interesting feature of the Garden. It is 308 feet long, 50 feet deep, and 70 feet high. The building is designed in the Italian renaissance style, and the classic order used is limited to two stories because these are the chief portions of the structure and are thus appropriately marked in their external character, and the upper story is thus left susceptible of freer and more varied treatment. The central feature is the dome of the reading room, which rises higher than any other part. The whole stands upon a basement which is masked by the approaches and terraces; thus the apparent height is lessened and the skyline varied without injury to the utilitarian interior. The materials are of white brick

and terra cotta with the exception of the marble columns. The principal entrance is on the first floor level, so that all of the public museum halls are up only one flight of stairs. This is accomplished by forming a terrace along the main front of the building reached by an inclined approach. The first floor of the building is devoted to economic botany and the specimens will include samples of barks, fibers, food, plants, timber, etc., the object being to show the plant and tree and fruit or product at all its various stages. The process of manufacture will be illustrated either

by charts and diagrams, or in some cases by models. Such apparatus as a cotton gin will be shown on a small scale with the raw material and the varied products. On the second floor of the building is the Museum of General Botany where types of each of the various families will be shown. The exhibition will be of a synoptic nature arranged with a view to pedagogical effect.

The third floor of the building is arranged for investigation purposes, with a library in the center. In the rotunda under the dome is the main reading room; adjacent is the stackroom, provided with metallic shelves capable of containing twenty thousand volumes. To the west of the library is the laboratory for plant embryology and cytology. Adjacent to this is the general morphological laboratory, the Director's office and a seminar room; adjoining and on the north-west corner is a specially constructed room with greenhouse for plant physiology, and an elaborate heating system makes it possible to secure any desired temperature. Research rooms, chemical laboratory and a photographic laboratory are on the west side of the floor. At the end of the library there is a large laboratory and various research rooms. Another east wing is occupied with a herbarium shown in our engraving, which is already equipped, as the large herbarium in Columbia University is in place with cases and specimens in perfect order. It is fitted up with oak tables and chairs, and is an ideal place for botanical study. It now contains between 600,000 and 700,000 specimens. In the library the Columbia University Botanical Library will be installed in the course of a few weeks,

and the garden has also acquired on its own account some valuable collections of books. The lecture room in the basement is practically complete and is arranged in the amphitheatrical form and will accommodate 720. In this room public lectures under the auspices of the garden will be given from time to time on botany and allied subjects.

Outside the museum building work is being carried on in the way of grading, planting, drainage, etc., vast quantities of porous tiling being used for drainage purposes. A 36-inch water main running through the grounds has been tapped for a 6-inch main, thus providing an adequate water supply, for it is necessary to use vast quantities of water in summer in order to promote the healthy growth of the plants. The power house is located directly on railroad and it will supply heat to the museum and the range of horticulture houses. A subway carries the steam pipes and electric wires from the power house to the museum.

Opposite the museum and fronting the Southern Boulevard are the horticultural houses. When completed they will be thirteen in number and will cover an area of 45,000 square feet. The central feature of the range is a palm house with a diameter of 100 feet, and it is nearly 90 feet high. From each side of the houses connecting wings 116 feet long and 30 feet wide will extend east and west. These houses have a cruciform termination, being 84 feet wide, 16 feet high to

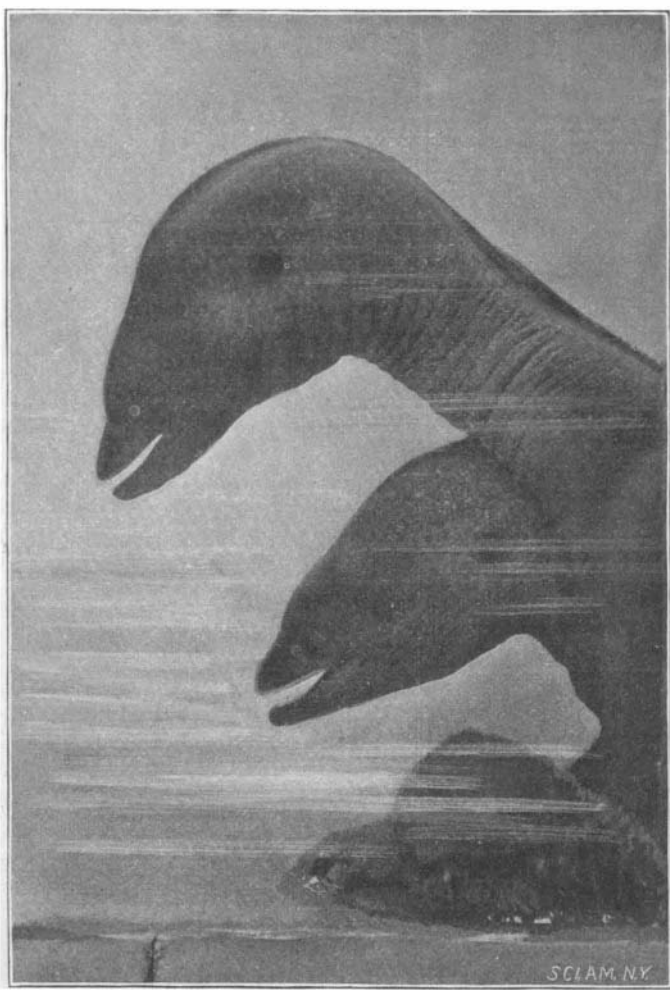
the main cornice, 38 feet to the lantern cornice, and 46 feet to the ridge. There will be various other connecting greenhouses. These houses are largely constructed of glass and the work on them is pro-

representative collection of the marine animals of this region, few, if any, of which have been seen or displayed alive.

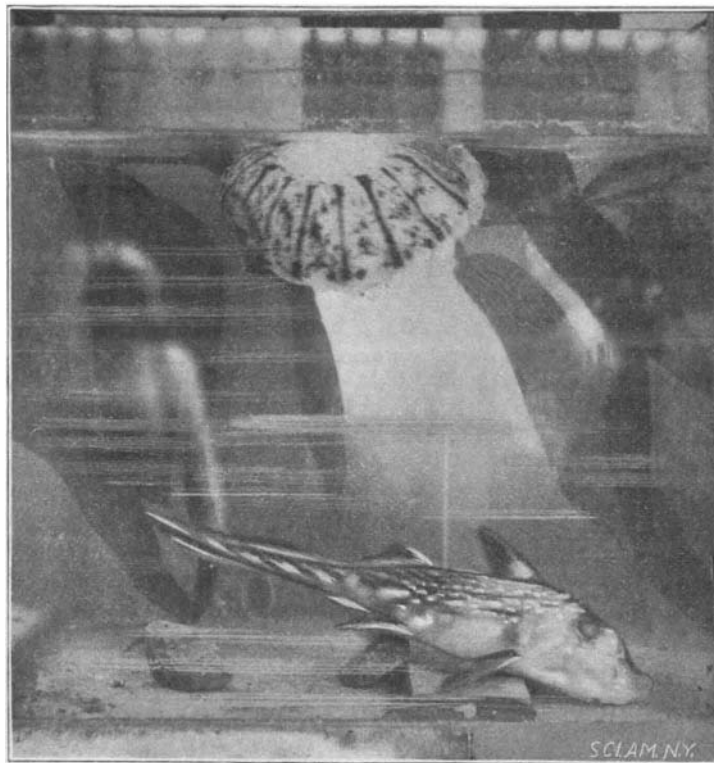
The aquarium is on the beach at the little town of Avalon, which is 3½ hours from Los Angeles. The present building is 60 by 20 feet with an end room for purposes of study. The tanks consist of one 60 feet in length, which can be used as a single tank or divided into ten or twelve compartments; this faces the sea. In the center of the building is a shark tank, 40 feet in length, with one division. In one end of the room are several small tanks, while the west or land side is also occupied by a row of small tanks 3 by 4 feet. The water is pumped from the bay to large reservoirs about 150 feet above, and from there runs down and is distributed by the injectors which aerate the tanks.

The conditions here are almost identical with those of Naples, only the climate at Avalon is almost perfect, the temperature ranging not much over 10 or 12 degrees between winter and summer; hence the dangerous changes which threaten some aquariums are reduced to a minimum. On entering the aquarium a tank of corals is first seen. Here is a beautiful branching scarlet gorgonia brought up in the channel from 600 feet of water, a large and heavy branch of coral and an attractive glass sponge from the same depth. The floor of the tank is sandy and on it are the "sea pansies" of the layman, or renellas cousins of the corals, throwing out long white polyps. The coral *Dendrophyllia* is seen here; the polyps when alive are a rich sulphur yellow. A line of small tanks follow, all tastefully arranged with living algae. In the first are two remarkable fishes known as "drums," from the fact that they utter a loud grunting sound that can be heard all over the building though made under water. They are about a foot in length, the eyes directed upward, as in

the case of the star-gazer, and on the lower surface and sides is a remarkable arrangement of mother-of-pearl spots apparently like those of *Scopelus*, also found here. The next tank is devoted to the great key-hole limpet, its velvet black body concealing the shell and in sharp contrast to the great yellow foot, almost 6 inches long, that is fastened to the glass. In the adjoining tank are young rock bass, their beautiful eyes an interesting study. Then comes a tank



LIVING FISH IN THE SANTA CATALINA ZOOLOGICAL STATION.



COLORFUL JELLY FISH AND FISH PHOTOGRAPHED UNDER WATER.

ceeding very rapidly. Palms, ferns, and tropical fruits will form a feature of the taller houses, while one of the low connecting houses will cover a pond for the aquatic plants. Heat will come from the power house which supplies the museum. The garden staff, which is already doing most efficient work, is under the direction of Dr. Nathaniel L. Britton, to whom we are indebted for courtesies in the preparation of the present article. The members of the staff are Dr. D. T. MacDougal, director of the laboratories, Dr. John K. Small, curator of the museums, Dr. P. A. Rydberg, assistant curator, Samuel Henshaw, head gardener, and there are other assistants.

#### PHOTOGRAPHING LIVING FISHES AT SANTA CATALINA ZOOLOGICAL STATION.

BY PROF. C. F. HOLDER.

The islands of the Southern California group, especially Santa Catalina, which has a town and mail service to and from every day in the year, have long been an interesting field to the zoologist, the fauna being in many respects peculiar. The "Albatross" has dredged here, and doubtless the National Museum has a very perfect collection representing the deep sea life of the adjacent channel and the submarine plateau that reaches away from the various islands. To place the representative forms of life here within reach of the public, students, and teachers, the owners of Santa Catalina Island have opened a zoological station and equipped it with a very creditable aquarium, so being able to present to the teachers of the National Educational Association, which met in Los Angeles, a fairly

of the smallest of the surf fishes—the shiner; a family group that was born here in the latter part of June. Like others of this family of fishes, they were born alive. The parents are four or five inches in length, and the young at present an inch and a half long. Each female gave birth to six or eight young, which were expelled tail first, and were at once capable of taking care of themselves, making no attempt to follow the mother, though they schooled. These little creatures are very tame and readily feed from the hand. The young males are beginning a unique courtship, which consists in penning a female in a corner and darting about her, pretending to seize food with open mouth and carry it to the demure female that remains in a given position. The male observed at this time drove off all rivals. The autumn—September and October—is the so-called mating time. In the following small tanks are young marbled morays, kelp fishes and some singular deep-sea spider crabs that were taken from a depth of six hundred feet. To all intents and purposes they are dead, so slow are their movements.

In the center of the hall is a long tank filled with macrocystis and various algae, in the center of which is a notable group, consisting of three or four marbled morays—huge creatures of great bulk, veritable sea serpents, their mouths open, showing sharp fanglike teeth. Swimming up and down about them is a young sheephead, rock bass, curious kelp fishes that mimic the leaves, and others. Two large sting rays press their grotesque faces against the glass, provoking much amusement from those to whom they are new,

The most interesting features of this tank are the Port Jackson or horned sharks, the group comprising old and young, male and female and eggs. They are types of a very ancient race, and thrive well under all conditions. The eggs are peculiar corkscrewlike objects of horn, which in the winter are washed up by every storm. Adjoining this tank is one containing bass and perch of various kinds, and next to this a larger tank with mussels and crayfish—the local lobster. A smaller tank is given over to a giant of the tribe whose shell was thrown off but a few days ago. From here extends a series of tanks whose occupants would delight the eye of an Eastern naturalist. Here is the king of the sculpins, so called, the great dink and marbled bullhead; then a compartment carpeted with *Serpula* of hues of the rainbow, their spiral breathing organs twisting and winding, disappearing and reappearing like magic. With them is the graceful *Virgulia*, dredged from the deep sea, dozens of interesting *Terebratulæ*, with pink shells and pseudo-skeleton within.

Then comes a tank of young "Garabaldis," illustrating the difference between old and young fishes in color. The adults are pure deep red, the young golden red, with blue splashes and dots so iridescent as to give rise to a popular local name, the "electric fish," many fishermen believing that they have seen sparks and flashes from them. Here is a series of the Southern California sheephead *T. pulcher*, from the adult males confined in separate tanks to prevent them from fighting, to the young. The old fish is a striking object, its blunt head pure black, its lower jaw pure white, a deep red band in the central portion, and the tail black. The very young one is a pale pink with black spots on its dorsal and anal fins—a brilliant little creature. The next stage it is all pink, the eye spots having disappeared; then in a larger fish some are fiery red, some white; still larger the stripes or bands are fairly outlined. Following are tanks of large black echini, the big California red crab, the giant spider crab of this coast, holothurians with plant-like breathing organs, all decorated with the delicate kelps and weeds peculiar to this region. In a large tank is massed a school of angel fishes, and in a still larger one a mola or sun fish lazily fans itself, while several dogfishes from the deep sea and a yellow-tail nearly four feet long eye it suspiciously.

In the jelly fish tank a *Rhizostoma* stretches away like a comet, and various delicate forms are seen, such as the *torepods*, a long chain of *salpæ*, *physophora*—the latter one of the most beautiful objects seen here; its rapid movements and lovely coloring assuring it much attention. Floating on the surface of several of the tanks are *velellas* with glossy sails and deep blue tentacles. The mollusks are extremely interesting. Perhaps the most showy, seen from time to time, and at short intervals, are *pterotrachia* and *carinaria*, attaining large size, *pteropods* of several species, which cling to the weeds and are remarkable mimics, as *doris*, *tethys*, and *aplysia*, the latter feeding from the hand, taking the rich green *ulva* with avidity.

Several species of *haliotis* cling to the glass or rocks, and a *trochus* shell, covered with a deep orange sponge, moves slowly, while the *marbled* *dbulla*, or bubble shell, leaves a curious silken web as its great foot glides along. A rare spined *murex*, *boatshells*, *aviculæ*, *oysters*, *mussels*, *mytilus*, and others are seen feeding upon weed or kelp. A small tank contains a group of *ascidians* from deep water bottoms, forms with rough surfaces in strange contrast to the elegant *salpæ*. Among the *corallines* are *retepora* and others, and the living *polyps* of *dendrophyllia* in sulphur yellow tints are fastened to various shells and the large tubes of worms. In the starfish tank is the large form, thirteen or fourteen inches across, common here, a deep red starfish. *Asterias* and several snake stars, *ophidium* and others; the last named being difficult to keep alive.

Among the interesting experiments here have been efforts to keep the deep sea "rock cod," and the yellow-tail, *Seriola dorsalis*. The latter is a very active fish and rarely survives longer than a week. They are so common that they can be frequently replaced.

It has generally been considered well nigh impossible to photograph the fishes in an aquarium, but some fairly successful plates have been made here by Mr. N. Swenson, of the mottled moray, the chimera, the sheephead and others. True, they are not so perfect as could be desired, but are excellent when it is remembered that it is a difficult matter to induce fish to pose. The morays opened and shut their mouths, the sheephead moved its fins, but the chimera was photographed without any trouble. The chief difficulty was in keeping out the reflections, which appeared as white spots.

This is the first aquarium and attempt at a zoological station in Southern California, and the first time the marine fauna has been seen alive. The exhibit has been visited last summer by many students and teachers of natural history, and the institution will be come a valuable adjunct to the school system of Southern California.

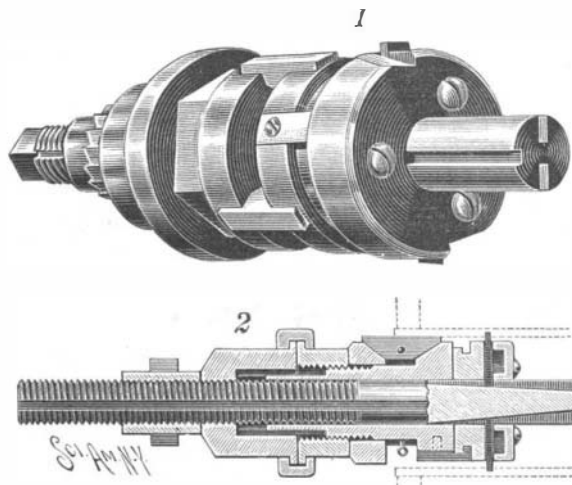
AN IMPROVEMENT IN FLUE-CUTTERS.

The flue-cutter which we illustrate in perspective and section was invented by Mr. Philip J. Kruger, of Greenville, Ill., to fill a want for a device by means of which a flue could be cut at the inner side of the sheet without forming a bur, thus leaving the flue in perfect condition to have a piece welded on the end, so that it could be used again.

The cutter comprises a central screw-shaft provided with inclined channels to receive the ribs of the cutter-carrying head. Owing to this arrangement the cutter-head is free to rotate with the shaft; and the shaft has longitudinal movement through the head. Cutters carried by the head are adapted to be moved outward by a longitudinal movement of the shaft and inward by a spring. The shaft is mounted to rotate in a sleeve on which clamping-blocks are supported by a spring-ring. On the sleeve a ring is mounted for forcing the blocks outward, which ring is in turn forced longitudinally by a nut engaging a feed nut on the shaft. The abutting portions of both units are engaged by a locking collar. A second sleeve removably engaging the shaft but rotating therewith has ratchet-teeth on its outer side, which may be engaged by a suitable tool to turn the shaft. This second sleeve brings the torsional strain upon the shaft nearer the cutters than in most similar devices.

In operation the cutter is placed sufficiently within the flue, as shown by dotted lines in Fig. 2. By rotating the sleeve-nut, the sleeve-ring is forced forward, causing the clamping-blocks so firmly to bind against the interior of the flue that the slightest movement of the sleeve and connected parts is impossible. Then by rotating the central shaft, to move it inwardly, the inclined walls of the channels will gradually force the cutters outward as they are carried around with the head.

The inventor has subjected his cutter to severe tests



KRUGER'S FLUE-CUTTER.

and has found that flues can be cut with a gratifying dispatch and facility.

Water-Plants as Land-Winners.

In *The Naturalist* for August, Mr. Albert Henry Pawson makes a brief contribution to the study of the influence of water-plants on the land surface. "There are several ways in which these plants tend to diminish the water-space and to increase the dry land. By their own decay they form vast masses of vegetable soil in shallow waters and on water margins; by occupying running streams they moderate the flow of the current and give it time to deposit its silt; by their creeping rhizomes and spreading roots they fix the bed of a stream and prevent its being scoured and deepened by floods, and again in times of flood they serve as a sieve or strainer, arresting all floating and much suspended solid matter." This is indeed a familiar theme, but the author discusses it with freshness and with appreciation of its dramatic interest. "Inch by inch, as the result of this accumulation and decay, the land creeps in upon the mere; more and more solid grows the edge; the aqueous plants retreat from the now shallow margin, the terrestrial plants advance, finding firmer footing; the sedges and reeds crowd on their floating neighbors which need space, and cannot endure the shade; these, too, press forward, and the open water grows less and less; it is invested on every side, and it is plain that its complete subjugation is now only a matter of time." It would be of interest to procure some actual measurements of the amount and rate of land-winning, and to study in minute detail the elimination which proceeds as the mere is closed up.

A BLUE grotto like that of the island of Capri has been discovered on the shore of the promontory of Skinari on the Ionian island Zante. The entrance is from the sea, and is larger than in the Capri grotto, but the interior is smaller. Fishing boats can make their way in when the water is calm.

Correspondence.

A Suggestion to High Speed Railroad Engineers. To the Editor of the SCIENTIFIC AMERICAN.

Railroad engineers who travel at a high rate of speed are painfully aware of the peculiar and trying effect upon the nerves of the eyes, caused by objects on the side of the tracks which in effect flash by them, and distract the gaze, which should be fully concentrated straight ahead.

To obviate this, and at the same time relieve the strain on the optic nerves caused by these distracting influences, let the engineer wear a pair of short tubes, say of about three-quarters of an inch in length and painted a dull black on the inside, over the eyes.

These tubes could easily be constructed of some light substance, and made to fit like ordinary spectacles.

Besides the restful effect these tubes produce on the eyes, they at the same time render the vision wonderfully clearer by cutting off all diverging rays of light.

ARTHUR SMEDLEY GREENE.

Port Jefferson, L. I., November 9, 1899.

The Funafuti Expedition.

The Funafuti Boring Expedition has very recently led to the rectification of a common ethnographical error, and the discovery of an interesting fact in zoogeography. In the monograph on the atoll of Funafuti published by the Australian Museum, Sydney, Mr. E. R. Waite referred to a large undetermined fish known to the natives as "Palu," and to traders as "Oil-fish." According to Mr. Louis Becke, a full-grown Palu would weigh up to 150 pounds and be 6 feet long; the average size is about 3 or 4 feet, and weight 40 to 60 pounds. The natives have many superstitions in regard to Palu; every portion of it is edible, even the head and bones when cooked turning into a rich mass of jelly. The flesh of the Palu, if left uncooked, never putrefies; it simply dissolves into a colorless and odorless oil. Perhaps the great regard the natives have for it is due to the fact of its being a rapid and powerful purgative. It is a deep water fish, and is usually caught at a depth of from 120 fathoms down to 200 fathoms; the fishing is only done at night. The Palu fishing hook has been described by Mr. C. Hedley, who points out that this large hook, which is widely distributed in the Central Pacific, and may be seen in most ethnographical collections, has been described by all authors as a "shark-hook." The last expedition to Funafuti has been fortunate enough to obtain a specimen of this fish, and in an appendix Mr. Waite has solved the riddle, and found that this mysterious fish is the well known *Ruvettus pretiosus*, which hitherto was known only from the North Atlantic, and whose recorded range is now enormously increased. The Escolar (Atlantic name) has been taken at depths as great as 300 and 400 fathoms, but can be taken only at night in September and the early part of October. —Nature.

The Current Supplement.

The current SUPPLEMENT, No. 1248, is a most interesting and valuable one. The first article describes "A Unique Departure in Engineering Education." The article illustrates the ceramic school of the Ohio State University, of which Prof. Edward Orton is the director. It is accompanied by illustrations showing the work being actually carried on. "Causes for the Adoption of Water-Tube Boilers in the United States Navy" is by Rear-Admiral George W. Melville, Chief of the Bureau of Steam Engineering, U. S. N., and is an important paper dealing with the advantages and disadvantages of such boilers. "The Modern Armor-Clad" is the first installment of an article illustrating in detail the actual construction of a battleship or armored cruiser. "Designs for the 'Denver' Class of Sheathed Protected Cruisers" is by Rear-Admiral Philip Hichborn, Chief Constructor, U. S. N., and gives in detail his views regarding the class of cruisers with which our readers have already been made familiar. "Krupp Armor-Plate Tests" describes important tests. "Effect of Hydrocyanic Gas upon the Germination of Seeds" is an interesting paper by C. O. Townsend. "A Problem in American Anthropology," by Prof. F. W. Putnam, is concluded. "The Explosive Side of Acetylene" is by F. H. McGahie.

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