

senting the mill and shop owners who have sent their ambitious sons and successors-to-be to these institutions, realizing that the instruction there given is equally practical and far more thorough than is obtained in their own mills or shops, besides including a host of things that neither weave room nor machine shop can teach.

No man of intelligence denies that theoretical courses are of primary importance in affording mental discipline not to be derived from practical research. So in these schools, theory and practice are made to go hand in hand, on the basis that from continual and practical applications of theoretical conclusions a broader and more tangible conception of their truths may be derived.

An excellent example of the practical plane the technical school has gained is Georgia's State School of Technology. The manufactures resulting from the work of the students, where the product is not for the use of the school itself, are sold, just as the output of any other producing plant is disposed of. The student understands from the first that his work is practical, and he is required to exercise the same energy and skill he would devote to his task if his daily bread depended on the result of his efforts.

The growth of the textile industry in the Southern States has resulted in an increasing demand for executive mill men, superintendents, and others, who combine with the practical training the mills give that knowledge which runs to cause and effect, what may be called the higher education in textile matters, including a sound foundation in engineering subjects.

So the technical-school course includes, besides the usual subjects of the textile school—such as carding, spinning, weaving, designing, and dyeing—extensive courses in chemistry, physics, mechanics, drawing, strength of materials, steam engine, electrical work, mill construction, and shop work.

The course not only covers the theoretical sides of the different subjects, but is extremely practical. For example, with a few exceptions where very fine or fancy yarns are required, students make and dye all the yarn used in the weave room. This yarn and the cloth product are kept up to the standard as jealously as in the mills of the highest class, because the product is placed on the market and sold.

The subject of fabric structure is given especial attention in its relation to the different combinations of textures and weaves, the classification of fabrics, the "balance of cloth" necessary to give the maximum of wearing qualities, and best general appearance, influence of twist in the appearance of the fabric and on textures, the influence of the texture on the appearance of the weave.

Formation of fabrics by interlacing threads introduced at right angles is included in the instruction in fabric design, as well as the three foundation weaves, the plain or cotton weave, the production of fancy effects on a plain weave foundation, the various features of twills and satins. All these, and much that is taught beside, enable a student to learn the origin and application of all the simpler weaves used in designing the various classes of textile fabrics.

Every effort is also made to familiarize the student with the rules and best systems of cloth analysis. He is furnished with samples of every grade of cotton fabrics, and his analyses thereof are thorough.

As a preliminary to carding and spinning instruction, or it may be termed a preliminary course, a study is made of cotton fiber, including botanical classification of cottons. The cotton-producing districts of the world and their products are studied. Commercial grading and classification and the chemical and physical properties of cotton are also considered.

Ginning, mixing, the picker room, and carding are taken up in detail, practical instruction therein being given with marked thoroughness. In fly-frame practice proficiency is required in the use of a 32-spindle slubber with improved differential motion, a 42-spindle intermediate, 72 and 64-spindle fine roving frames, 96-spindle jack frame, roving reel, and scale and roving trucks.

It is required of a student in ring spinning that he be thoroughly up in all calculations pertaining to carding and spinning, the grinding and setting of the cards, and the manipulation of white and colored stocks. This knowledge only comes in time, to be sure, but it is demanded of a student that during his course he gain the necessary knowledge. Every student must produce a stated amount of warp, filling, and twist yarns. He must also be able to take apart, re-erect,

repair, and care for 80-spindle, 64-spindle, and 160-spindle combined warp and filling frames, an 80-spindle filling frame, a 360-spindle 1½-inch gage spinning mule, and a dozen other of the most modern machines used for twisting, spooling, winding, and reeling. Lectures, recitations, demonstrations, and practice on all the most modern looms constitute the weaving curriculum.

A technical knowledge of dyeing is of marked importance to a textile manufacturer. It is, therefore, a fact of interest that in the thoroughly up-to-date technical school, the laboratory and dye house form a feature of note. The object of the course in dyeing is to give the student a clear idea of the fundamental principles which underlie the arts of bleaching and dyeing. This is done by experiment and research, assisted by lectures. Every student is required to properly bleach cotton cloth and yarn and to dye several kinds of textile materials. As a result, he gains expert knowledge concerning artificial coloring matters, compound shades, matching off, testing and valuation of dye stuffs, detection of dyes in the fiber, comparative tests, and the manufacture of dyes.

Besides understanding the different processes of cotton manufacture, a mill superintendent is called upon to manage the motive power, operation, and general economy of an entire plant. This knowledge is gained in the technical school by a thorough course in mechanical engineering, including investigation of the laws of statics, the underlying principles of the various general features of machinery, dynamics, strength of materials, the steam engine, power transmission, machine design, mill construction, ventilation, and sanitation. The department of physics in a technical school affords an excellent illustration of the thorough nature of the training. As a rule, physics are not

two bear much the same relation as the grammar school and the university.

In the workshop the entire force of knowledge of the student in mechanical engineering is called into play by his work in the machine shop, smithy, foundry, and woodshop. Throughout the first or apprentice year two days of eight hours each are devoted weekly to shop practice. About two-thirds of this time is spent in the woodworking shop. When sufficient skill has been attained to begin elementary pattern work, the student goes to the foundry, and is given elementary practice in molding. This enables him to understand the conditions imposed by the foundry upon the pattern maker. The remaining three years of a course are generally divided, as regards this class of work, between pattern making, foundry, smith shop, and machine shop. Here the student becomes expert in his understanding, in his practical knowledge, of the work that is always performed in establishments of this sort.

It is apparent that the mission of the technical schools of to-day consists largely of training the rising generation of those who are grouped under the title "captains of industry." They teach not only what the superintendent, the man of affairs in manufacturing work, must know in order to completely discharge his own duties, but they train him as well to look at the applied principle of work from the standpoint of the man at the loom, the forge, the dynamo.

THE LATEST IN CYCLES.

A novel bicycle has been built in London which has been pronounced "as comfortable as a rocking chair" and which shows remarkable mechanical ingenuity. This new machine is fitted with an anti-vibrating easy chair-like saddle which affords wonderful relief to a tired back and which proves a luxury when coasting down long hills. The ladies' machines are meeting with particular favor. They are of exactly the same construction as are the machines built for the men. The illustration gives some idea of the comfort found in these new bicycles.

Besides the chair-like saddle, the machine has another improvement. Note the position of the handle-bars. They are almost directly under the saddle. It is this arrangement that enables the woman to ride the diamond frame with ease. The steering gear is under perfect control and it will be seen that a smaller circle can be described on this machine than on any other.

The first machine of this make was built by P. W. Bartlett, of Richmond, England, for a Java resident. He was so pleased that he has now placed an order for twelve more of the same construction. The weight is somewhat greater than that of the light-weight racing machines, but as these bicycles are built for comfort and not alone for speed this is no detriment. The cost is the same as of any other high-grade bicycle.

THE REMORAS.

BY CHARLES FREDERICK HOLDER.

Any one who has spent any time in Southern waters, or engaged in shark fishing, is familiar with the remarkable fish, remora, shown in the accompanying photograph clinging to the glass by its singular sucker. Nearly all sharks have attendant remoras. I have found them on the swordfish, drum, black grouper, and even upon turtles in the Mexican gulf, and have also caught them when none of these fishes was in the vicinity. When a large shark is seen near the surface, on its dun-colored hide, or against it, will be seen a very distinct black streak parallel with the body about a foot long. Often several will be seen. If at such a time bait is thrown over, the black streak separates itself from its protector and appears as a long, slender, flat-headed fish, the remora, that in a sense is parasitic upon the shark.

So strong is the instinct of the remora to cling to the large fish that in most instances it will refuse to leave it when the latter is hauled out of the water, clinging with such energy that it can only be torn away by the display of much strength. I have seen them come ashore on the hammerhead at Santa Catalina, a huge specimen which I captured after several hours, and which only started inshore when four boats were made fast to it. I have also seen it on the sand shark and the white shark in the Mexican gulf, and doubtless other large fishes are used as a refuge by one or more species. The remora is easily "tamed." I have kept



How the Bicycle is Ridden.



End View of the New Bicycle.

THE LATEST IN CYCLES.

attempted until the student's second year, when his work has fitted him for the solution of the problems that will present themselves. Every modern appliance, or more correctly the most important of these, are utilized in the course of instruction, the Olsen testing machine and the throttling calorimeter being notable examples. It is an interesting fact that in several technical schools the students have constructed some of the most important of the apparatus in use.

A broad foundation in general and theoretical chemistry is established, so that in future work new problems may be intelligently met and solved. Especial instruction is given in industrial chemistry. The knowledge he gains here will enable and has enabled the graduate student in business life to determine the relative value of the raw materials offered by dealers, and to conduct intelligently operations based on chemical principles, detect imperfections in them, and suggest improvements. He is prepared in this way to undertake analytical work of almost any description.

So the student gains a practical knowledge of quantitative analysis, consisting of general, applied, and analytical chemistry; inorganic chemistry, qualitative analysis, general methods, applied analytical chemistry; fuel, iron and steel, water, and fertilizer analyses; oil testing, organic chemistry, metallurgy, and physical chemistry.

It is plain that the commercial helpfulness of the graduate of a technical school is based on what he can do, rather than on what he knows. Throughout the various courses of a technical school of the first class not an instructor is permitted to either forget the urgency of this principle or to allow his pupils to lack appreciation thereof. So what is known as workshop practice must not be classed with manual school training, valuable as the latter undoubtedly is. The

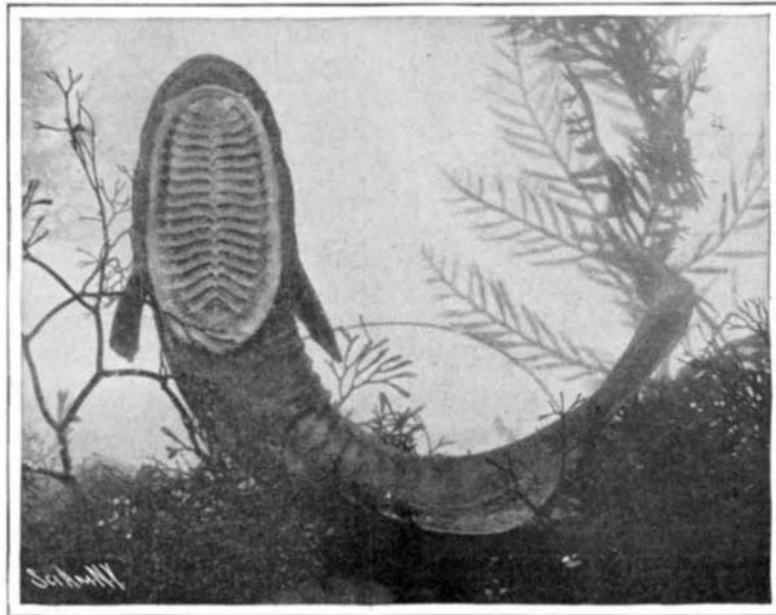
several in confinement to experiment with, and legend and pseudo history have played many merry pranks with them. Thus the old Romans called them ship stayers, and several of the classics contain references to them—fishes that fastened themselves to the war galleys and aided in their defeat by holding them back. It will be remembered that Pliny, among others, gravely informs us that Antony's ship at Actium was held by a remora, though several hundred sailors pulled at the oars. Then, too, we are told that Caligula's ship was held between Astura and Actium by a remora that was seen clinging to the rudder, pulling successfully against the oars of four hundred stalwart seamen.

The peculiar feature of the remora is the large sucker on the top of its head that is so conspicuous that an observer who had never seen one would select the belly as the dorsal surface. The fish appears to be tipped upside down; but as stated, the sucker is on the top of the head, and doubtless is a modification of the first dorsal fin, forming a perfect sucker which clings so tightly that I have lifted a bucket full of water by allowing the fish to attach itself to the bottom and lifting it by the tail. This sucker resembles a Venetian blind with its cleats, being made up of cartilaginous plates in a double series whose edges are sawlike or serrated. This disk is on the head and neck and often overhangs the mouth and always the eyes, calling to mind in a very superficial way some of the hornbills among birds.

The lower jaw generally projects beyond the upper. The fish is dark, or lead colored, sometimes striped, and presents a singular appearance as it swims about. I once saw a very large man-eater, possibly fifteen feet in length, swimming about my boat, in a deliberate fashion, and as attendants it had six or seven remoras and as many pilot fishes. The latter swam near its head, venturing only a few feet away, while the remoras roamed about in every direction, and when I threw pieces of crayfish into the water they rushed at it greedily but were not joined by the pilots.

There are several genera, as *Phtheichthys*, *Echeneis*, *Remilegia*, *Remora*, and *Rhombochirus*. One of the most interesting remoras is *Phtheichthys lineatus*, as it has two very pronounced white bands running laterally, which give the fish a very striking appearance. In specimens preserved in alcohol or formaldehyde the stripes fade out, but in several which I took from a large hammerhead shark off Avalon Bay, Santa Catalina, the stripes were pure white and the fish a very dark blue black, a most conspicuous object, long, and very slender. I find no record of the fish having been seen on the Pacific coast, Jordan giving its range in the Atlantic north to North Carolina and Pensacola. It is said to attach itself to barracudas in the Atlantic or Gulf of Mexico. I have never noticed this, although I have taken by grain and line many specimens of this large fish. The Bahaman barracuda, at least on the outer reef, is a "solitary." It lurks in

appears to be a world-wide roamer, carried hither and yon by large sharks, and common on each side of the continent, and especially in southern seas. It is this remora of which the story is told that fishermen employ it in the Caribbean Sea to catch turtles. The remora is kept, so runs the story, in a pail; a ring is placed about its tail and to this a line. When the men sight a turtle the remora is slipped overboard and it is supposed darts at the turtle, seizes it, and holds on with such firmness and vigor that the animal can be hauled in. I lived on the Florida reef, winter and



THE REMORA, SHOWING SUCKING DISK WITH SEVENTEEN LAMINÆ.

Taken from large shark at Santa Catalina Island, Cal.

summer, several years and had a remarkable experience with the various fishes, and among other things I experimented with the remora; but the fish invariably refused to dart after the turtle, preferring to find shelter under the boat. One tossed at a shark was seized by the latter, that doubtless thought it a votive offering. Possibly something was wrong; our remoras may have been stale; they surely were not ship stayers, or turtle. I do not mean to insinuate that this tale is not possible, as so good an authority as Columbus refers to it, and in 1884 Mr. Frederick Holmwood, British consul at Zanzibar, described fishing with the remora in that latitude. The fishes, it is said, are kept in a well, and the ring is so firmly placed on the tail that it becomes imbedded in the flesh, so that a large turtle can be caught by them.

This remora is found as far north as Gloucester, and Monterey on the Pacific side, and is the common ship stayer of song and story. Two presumable species have been described; one with from twenty-two to twenty-six laminae, and another with from twenty to twenty-one. A rare and little known remora is *Remilegia australis*, described by Bennett, and found clinging to a dolphin in tropical water seas. It is a rich

Nantucket and Block Island in the summer, and occasionally found on the large swordfishes of the latter waters. It is also common on the Florida reef, and said to follow the big sailfish of Cuban waters.

The so-called white remora, *Remora albescens*, which is not white, rather a gray tint, has thirteen or fourteen laminae in the sucking disk. It is found in the warm waters of the Pacific Ocean, and doubtless strays north in summer, when many large varieties of sharks go north.

A similar remora is included in the genus *Rhombochirus*, having been found on the swordfish *Tetrapturus* on the Atlantic coast ranging from the West Indies north to Cape Cod. A fossil remora is known, described by Cope as *Opisthomyzon*. It was in general appearance more normal, according to Storms, than the typical remoras of to-day. Its head was not so flat, the jaws were equal, the head was narrower, and the sucking disk much smaller than that of the remora of to-day. In all probability, the fish was more active, a better swimmer, and not so dependent upon other fishes as are the present forms. Very little, if anything, is known of the breeding habits of remoras. In Florida I kept them in dead coral inclosures in order to watch them, but could never find the young.

Few more interesting groups of fishes are known than the remoras, which have figured in legend and history, well known to a few, rarely if ever seen by the majority. The accompanying illustration is a photograph of the fish in the water, taken at Santa Catalina Island, California, under my direction by Charles Ironmonger. It shows the sucker and its partitions perfectly, and doubtless is the only photograph ever taken of the remora, as the fish is rarely caught except when sharks are brought in alive.

THE GREAT SEA WALL AT GALVESTON.

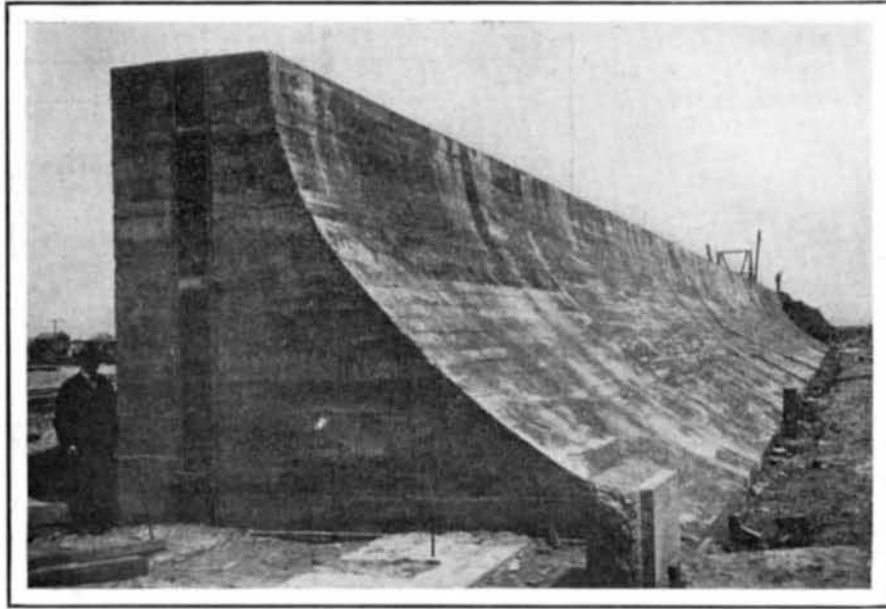
BY W. S. HUDSON.

The completion of Galveston's great sea wall marks the first step toward making that city, the most important port on the Gulf coast, storm-proof for all time to come, and also marks the successful culmination of one of the most unique and gigantic engineering undertakings in recent years. The building of a solid concrete wall 4½ miles in length and seventeen feet high and the elevation of the city's grade to the level of the top of the wall is an achievement of which any city twice the size of Galveston might well be proud, and when the conditions under which this undertaking was begun are considered, the wonderful nerve of Galvestonians is more properly realized.

Although repeatedly warned to take some measure for the protection of the city from the occasional overflows of the Gulf, it remained for the great disaster of September 8, 1900, to bring the people of Galveston to a complete realization of the necessity for such protection. In the great storm of that date over 8,000 lives were wiped out of existence, more than \$20,000,000



BUILT OF GRANITE AND CEMENT, THE GALVESTON SEA WALL IS 4½ MILES LONG AND WEIGHS 40,000 POUNDS TO THE FOOT.



THE GALVESTON WALL MEASURES 16 FEET AT THE BASE, IS 17 FEET HIGH AND 5 FEET ACROSS AT THE TOP.

certain places, remaining quiet and poised for long periods, and has a habit, also distasteful to the remora, of swallowing its food entire without crushing it.

The remora affects wanderers like the shark, swordfish, and animals which, in their savage rush at prey, crush and macerate it, so that particles escape into the open water, which can be secured.

In *Echeneis naucratis* the disk is long and has from twenty to twenty-eight laminae. Its color is brown, with a dark belly, a dark stripe with a white edge extending along the side and through the eye. This

brown color and easily distinguished from other remoras by the size of the sucking disk, which is very large and elongate, and has twenty-seven laminae.

The genus *Remora* is well known, the species of that name being a dark fish about fifteen inches in length, with a large sucking disk, and found on the large sharks that are commonly caught at Santa Catalina in summer, especially the huge monsters that affect the grouper banks in the San Clemente channel. I saw four or five of these remoras on one large specimen and the same fish is taken on large sharks at

worth of property was destroyed, and faith in the stability of the rapidly-growing city so rudely shaken that five years have not entirely sufficed to restore public confidence. When the city had partly recovered from the overwhelming disaster the board of city commissioners passed a resolution calling for the appointment of a committee to select competent engineers to report upon the following:

1. The safest and most efficient way for protecting the city from overflows of the sea.
2. Plans and specifications and estimates of the cost