ranged along the sides in the wake of the engines and boilers and fill up the space between sloping deck and outside shell plating, and also the spaces between inside of slopes and engine and boiler rooms. When, as in the case of the "Edgar," the slope is 5 inches thick, this equals about 7½ inches vertical, and, adding the resistance of the coal, we get the equivalent resistance of about 12 inches of steel placed vertically on the sides of the ship. It is better, however, to burst the shells outside than inside the shell plating, and hence the armored cruiser is coming increasingly into favor in the present day.

The duties of the cruisers of the British navy will lie chiefly in the direction of protecting her enormous maritime commerce. They will be disposed at important points on the great trade routes, which they will patrol as long as any cruisers of the enemy are at sea. Undoubtedly at the outbreak of the war an effort will be made to watch the hostile cruisers, and keep them shut up in their own ports; but should they escape, it will be the work of this big fleet of close upon two hundred vessels to capture or sink them as quickly as possible. The enemy's commerce destroyers of over 21 knots will be open to attack only by such fast vessels as the "Powerful" and "Terrible," of 21½ to 22½ knots speed. In view of the terrible havoc that a 23-knot commerce destroyer could work on British commerce, it is strange that the government does not build a few powerful vessels capable of overtaking a craft of this kind. Two 15,000 ton armored cruisers of 23 knots are to be laid down shortly.

It is a remarkable fact that nearly the whole of this large fleet of protected cruisers has been built during the past ten years. The start was made when the alarm of the British public over the defenseless condition of their maritime commerce led to the passage of the Naval Defense Act of 1889, when $100,000,000 was voted for the construction of seventy new vessels. Previous to the passage of the act, the protected cruiser classes were represented by the "Blake" and "Blenheim," 9,000 tons, 21½ knots; eight ships of the "Forth" and "Leander" types, of 4,000 and 4,300 tons and 17 and 16½ knots; five ships of the "Magicienne" and "Medusa" types, 2,950 and 2,800 tons and 19 knots; the "Calliope," and "Calypso" (the former famous for its escape from Apia during the fatal hurricane), 2,770 tons and 14·6 knots; fifteen gunboats of the "Archer" and "Barracouta" classes, of 1,830 and 1,580 tons and 18·6 and 16·5 knots; besides some forty or fifty smaller and slower gunboats. Of these only the "Blake" and the "Blenheim" can be considered thoroughly up-to-date vessels.

The Naval Defense Act, in addition to 10 battleships, called for 29 second-class cruisers of the "Apollo" class, of 3,400 tons and 20 knots, and 9 first-class cruisers of the "Edgar" type, of 7,350 tons and 20 knots. Of these 29 second-class cruisers, 11 were built according to the original design, as follows: Displacement, 3,400 tons; speed, 20 knots; armament, 2 6-inch, 6 4·7-inch rapid-fire guns, and 14 smaller guns. Ten others were built of identical dimensions, etc., but were sheathed and coppered to fit them for tropical waters, the displacement being thereby raised to 3,600 tons. The names of the 21 vessels are as follows: "Æolus," "Andromeda," "Apollo," "Brilliant," "Indefatigable," "Intrepid," "Iphigenia," "Latona," "Melampus," "Naiad," "Pique," "Rainbow," "Retribution," "Sappho," "Scylla," "Sirius," "Spartan," "Sybille," "Terpsichore," "Thetis," and "Tribune."

To give them better sea-going qualities and a more powerful battery, the other 8 ships were built with 20 feet more length, the whole battery was placed on a flush main deck (instead of on a forecastle and poop and in a well amidships), and two additional 4·7-inch guns were added. These ships were known as the "Astræa" class. Their particulars will be found under Plate No. 6.

The names of these 8 ships are "Astræa," "Bonaventure," "Cambrian," "Charybdis," "Flora," "Forte," "Fox," and "Hermione."

The 9 first-class cruisers of the Naval Defense Act are known as the "Edgar" class. They are smaller editions of the "Blake," with the same battery, but 1½ knots less speed and a smaller coal supply. The dimensions, etc., of the "Edgar" are given under Plate 4. Five of the ships of this class: the "Edgar," "Endymion," "Grafton," "Hawke," and "Theseus," are similar to the diagram shown on page 376.

To improve their seagoing qualities, a raised forecastle deck was added to the other four ships, the "Crescent," "Gibraltar," "Royal Arthur," and "St. George," and the 9·2-inch bow-chaser was replaced by 2 6-inch rapid-firers. They were also sheathed and coppered, the displacement being raised to 7,700 tons.

The next addition to the navy included 11 second-class cruisers of the "Eclipse" class. Nine of these were built to the dimensions, etc., given below Plate 5. Their names are as follows: "Diana," "Dido," "Doris," "Eclipse." "Isis," "Juno," "Minerva," "Talbot," "Venus." As compared with the ships of similar size in other navies, the armament was manifestly light, and in three later ships of the class: "Hermes," "Hyacinth," and "Highflyer," eleven 6-inch guns were mounted in place of five 6-inch and six 4·7-inch.

The next important addition to the fleet cruisers consisted of two huge vessels, the "Powerful" and "Terrible," of 14,200 tons and 22½ knots speed. They were the first warships to have the length of an Atlantic liner, being 536 feet long by 71 feet beam. As will be seen from the front page engraving, they are imposing vessels, of handsome design. They have a flush upper deck throughout the whole length whose average height above the water line is about 32 feet. The main battery of two 9·2-inch guns is carried on this deck, the axis of the forward guns being about 38 feet above the sea. The battery of twelve 6-inch guns is disposed on the gun deck and berth deck below, four of the guns being in superimposed 6-inch armored casemates forward and four aft, the other four guns being in armored casemates amidships on the berth deck. The battery of sixteen 3-inch guns is disposed on the gun and berth decks, eight amidships, four in the bow, and four in the stern. The fire dead ahead or dead astern is one 9·2-inch, four 6-inch, and four 3-inch.

Apart from their size, these ships are remarkable as having been the first large ships in the navy to be furnished with a complete installation of watertube boilers. They are sheathed and coppered and carry the enormous supply of 3,000 tons of coal—more than they require, in view of the frequency of British coaling stations.

The next lot of first-class cruisers, known as the "Diadem" class, were smaller editions of the "Terrible." The poop is cut away (see diagram), thereby sacrificing gun command and officers' accommodations in favor of a saving of 300 tons of weight, the coal supply is reduced to 1,900 tons, and the speed is reduced from 22½ to 20½ knots, with a consequent reduction of the displacement from 14,200 to 11,000 tons. The two 9·2-inch guns are replaced by four 6-inch rapid firers, with the result that these vessels carry sixteen of these effective weapons, besides fourteen 3-inch rapid-firers and fourteen smaller guns. The vessels are all sheathed and coppered. The vessels in this class are as follows: "Andromeda," "Diadem," "Europa," "Niobe," "Amphitrite," "Ariadne," "Argonaut," and "Spartiate."

In Plate 8 we give an illustration of the "Pelorus," which is a good representation of the latest third-class cruisers of this navy. They are trim little craft similar to our "Marblehead," which is greatly superior to them in battery but inferior in speed and protection. The battery of eight 4-inch and eight 3-pounders is mounted on a raised forecastle and on the gundeck amidships. There are 11 ships of this class, and, including these, there are 44 vessels of the so-called third class cruiser type. They vary from 1,600 to 3,000 tons in displacement and from 16½ to 20 knots in speed.

Plate 9 shows one of the latest gunboats of the "Speedy" class, in which are 11 identical vessels of 810 tons and 20 knots speed. The 13 vessels of the "Gleaner" type are somewhat smaller, 735 tons, but have the same speed and armament. The four gunboats of the "Halcyon" type have a raised poop and displace 1,070 tons, the speed being 19 knots.

The torpedo flotilla of the British navy differs from that of the other Continental navies in the large number of torpedo boat destroyers that it includes in proportion to the number of torpedo boats proper. The official lists show 109 of the former built or building, against 187 of the latter; whereas the French navy has about a score of destroyers to 232 torpedo boats. Great Britain has practically given up the construction of torpedo boats, and has been content to increase her force of destroyers, for the reason that the destroyer is capable of running down and sinking torpedo boats, while at the same time it is capable of taking the offensive against battleships and cruisers, with at least as much prospect of success as the smaller, but slower, torpedo boat.

The torpedo flotilla is made up of 97 torpedo boats of the first class, which vary in speed from 19 to 23 knots, and 90 of the second class, with speeds of from 16 to 23 knots. The fleet of destroyers is made up of 42 boats of the "Hornet" type, 48 of the "Desperate" type, 5 of the "Albatross" type; a 33-knot boat, the "Express;" a 35-knot propelled by the Parsons turbine; and 12 vessels recently tendered for, of an improved "Desperate" type. The particulars of the different types of destroyer are given in the following table:

TORPEDO BOAT DESTROYER FLEET.

Name of Type.	No. of boats.	Length.	Displacement in tons.	Horse power.	Speed in knots.	Armament.			Complement.	Coal.
						12-pounders.	6-pounders.	Torpedo tubes		
Hornet	42	180	240	4,000	27·3	1	3	3	43	57
Desperate	48	210	300	5,400	30	1	5	2	58	80
Albatross	5	227·6	300	7,500	32	1	5	2	60	80
Express	1	227·6	300	10,000	33	1	5	2	60	80
Improved Turbinia	1	....	....	....	35	....	....	....	....	....
Improved Desperate	12	....	....	..	30	...	...	....	...	....

Of all the elements of a modern navy, the torpedo flotilla is the most uncertain and undetermined as to its value; but there is no doubt that, for the duties of such a navy as Great Britain's, the sea-going destroyer is preferable to the smaller and unseaworthy torpedo boat.

Summing up our review of the British navy, we consider that, in addition to the advantage that comes from numbers, the best features are the excellent sea-going qualities of the ships; the large supplies of coal, ammunition, and stores carried; the uniformity in the types due to building the ships in classes; the small number of patterns of guns, thereby avoiding confusion and complication in ammunition; and lastly, and perhaps most important of all, the excellent personnel and the undoubted esprit de corps of the navy.

The defects are, in the battleships, the unarmored ends, the fact that the breeches of many of the large guns are unprotected, and in the later cruisers the total absence of side armor at the water line. Most serious defect of all, however, and one that cannot be too soon remedied in future ships, is the fact that the ships, both battleships and cruisers, do not carry as powerful armaments relatively to their great displacement as are found in ships of other navies of the world. Ship for ship, the "Majesties" would probably be a match for any French or Russian battleships they might encounter, but, with their excess of 2,000 to 3,000 tons displacement, they should carry an overwhelming preponderance of armament.

THE SIPHON OF THE CLAM.

THE SIPHON OF THE CLAM.

BY C. F. HOLDER.

The interesting clam with elongated siphon shown in the accompanying illustration was taken at Long Beach, where the art of clamming is conducted in an interesting manner at times. Instead of the single clammer on the beach at low tide, often a picturesque object from the dunes, we see a man plowing a long furrow in the sands, hoping in this way to throw up hundreds of the succulent bivalves.

To those who frequent muddy shores at low tide, the hole of the clam is a familiar sight. Sometimes the latter is discovered near the surface, ejecting a spurt of water; and strange clicking, sucking sounds, the dulcet voice of the clam, have been heard by those who, out of curiosity, frequent its haunts.

In the accompanying illustration one of the most interesting features of bivalves is seen at its best, namely, the siphon, a singular continuation of the mantle, a fleshy chimney, so to speak, which enables the clam to rest at the bottom in security, and throw up this extension, and breathe and eat through it. The siphon in the cooked clam is a black, small, and retracted object, projecting but slightly from the shell; it is known as the head, a misnomer, as it is really at the posterior opening of the shell, and opposite the place where the head, if there were one, should be.

The siphon is a long, muscular, and exceedingly tough tube, really an extension of the mantle which incloses the clam, and, in this instance, divided into two tubes. To fully understand its office a glance at the internal economy of the animal is necessary. Opening a clam, we find next to the shells a delicate gray mantle that encompasses the animal, so that it appears to be a bag holding the body of the clam and protecting it. At the posterior end the mantle is developed into the siphon, which contains two tubes. Opening the shell wider, we have the various parts before us. On the lower side is a muscular organ called the foot, that in some shells, as the razor clam, is an extraordinary member. This foot in some species, as the mussel, bears a remarkable gland which secretes a fluid that,

when produced and exposed to the water, becomes a mass of dark, horny fibers that serve as anchor chains by which the animal attaches itself to the rocks. We find the mouth directly opposite the so-called siphon, provided with a pair of peculiar lips, leaf-like, which have the faculty of aiding in sending currents of water bearing food to the mouth. We see the long coiled intestine, the stomach, and liver, and in a bag or sac a marvelous rod, clear as crystal, seemingly distinct from the body and without purpose, a backbone unattached as it were, known as the crystalline style; an organ that is well known, but which is still a zoological mystery.

The heart is an interesting object, the blood pouring from the gills into the two auricles, then passing into the median ventricle, which pumps it into all parts of the body. The gills are prominent objects, apparently hanging on either side, and made up of a marvelously complicated series of tubes. If in imagination we could follow the blood current of the clam, we should see it collecting in a large tube at the base of the gills, from which it passes into the tubes and so to the heart. During the passage through the tubes which make up the gills the process of breathing is accomplished, which brings us to the consideration of the long siphon of the clam.

This singular organ has various offices. It is like the trunk of an elephant, inasmuch as it can be elongated to obtain food at a distance from the body, illustrated by the clam at the bottom of its burrow, while the tip of the pseudo trunk or siphon is at the opening receiving food. The siphon has two tubes; the one furthest from the hinge, or the lower, may be called the mouth proper, as it sucks in a continual current of water. The other performs an opposite work, rejecting the accumulation, and can be compared to a chimney, out of which passes the rejectamenta after consumption. In this one act of drawing water through its long siphon the clam eats and breathes. The water, laden with food and oxygen, is brought into the clam in a remarkable manner, which is readily observed. The gills and other parts of the clam are covered with minute, hair-like organs, which may be compared to oars, which all wave or work in a given direction, always away from the incurrent siphon opening, thus creating a current through it, the water from without rushing in to fill its place, and so powerfully do the cilia work that a few in a small section of the gills removed for the purpose have been known to move six millimeters in a minute. The water from the incurrent siphon, laden with food particles and charged with oxygen, is then wafted by millions of paddles over every portion of the gills, when the blood in the tubes takes up the oxygen and ejects the carbonic acid. On it passes, the cilia or paddles sweeping it on in the direction of the mouth, which, as it passes, seizes the atoms of food, the rejected portions, the impure water now laden with carbonic acid, being swept along and finally forced out of the upper tube of the siphon. So it will be seen that the perfect type of the siphon, with its two tubes, as illustrated by the clam, is a marvelous organ; and that the simple "head" of the clam, in popular parlance, is more like the tip of a long proboscis, really a very complicated and beautiful organ in all its parts, having various and important functions, interesting not only to the naturalist, but to any stroller along shore.

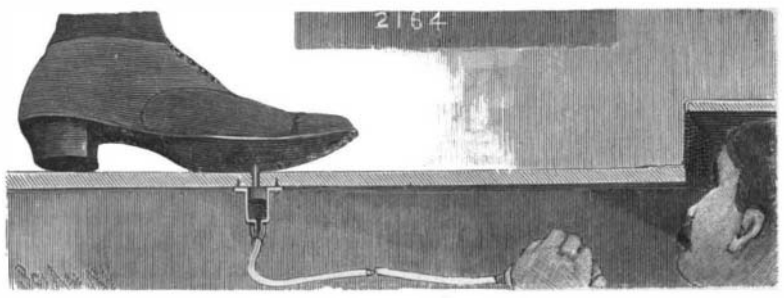
The mollusks are by no means the low creatures generally supposed. They are endowed with many senses; indeed, the wonderful siphon, like the trunk of the elephant, has such varied offices that it seems gifted with a special sense. The clam has olfactory organs, these being found in what is known as the parieto-splanchnic ganglia. It has minute eyes, in the pecten thirty or more are seen on the edge of the mantle, gleaming like gems. Sometimes the eyes are situated upon the siphon, as in the solen or razor clam. They are the simplest form of eyes, yet are sufficient to warn the owner, as every clammer knows, who has seen the wily razor dart down into its den as the shadow passed over it. The ears of the clam are delicate sacs, each containing an otolith, which, like the tongue of a bell, jangles against the cilia that line the sac, so producing sound waves.

A study of the siphons of the mollusks shows the greatest variety. The clam illustrates the maximum length. In the razor clam, ensis, and others, it is very short. In Tellina tenera the siphons are remarkably long, several times the length of the shell, and well illustrate the forms in which the siphons constitute separate tubes.

MENTAL WONDERS.*

The most sphinxlike problem ever presented to the public for solution was the second sight mystery. There have been many exposés of "mental magic," and some of the best of them are described in "Magic: Stage Illusions and Scientific Diversions, including Trick Photography."

We have now to concern ourselves with "mental magic," where the results are obtained by clever tricks. There have appeared from time to time before the public individuals who generally work in couples, termed "operators" and "subjects," who have given performances which were termed mental wonders, silent second sight, etc. The operator invariably tries to impose on the public with the idea that he possesses some mysterious power over the "subject," by which he is enabled to communicate information to her by his will power over her mind without a word being spoken. There are, of course, various methods of performing this trick, as by a code of predetermined signals in which sentences like the following are used: "Say the number. Well? Speak out. Say what it is." But these methods are not comparable with the mechanical means which we are about to describe.

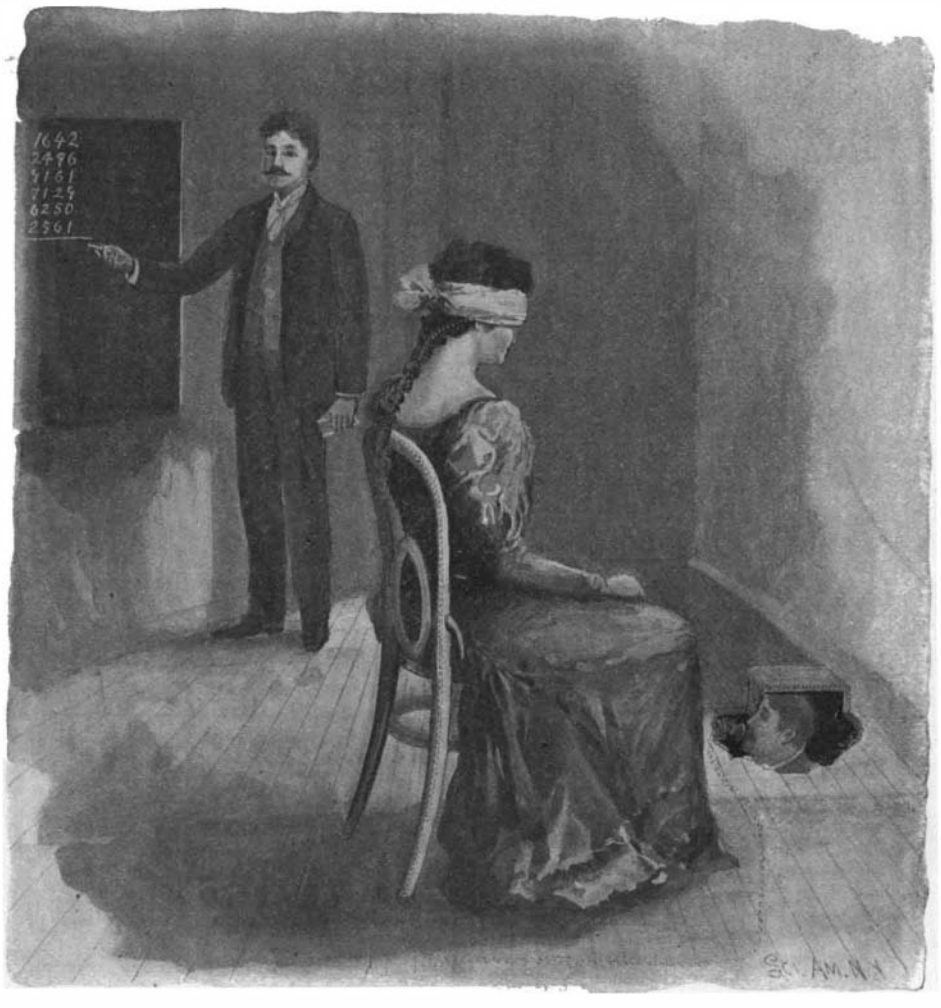


THE FOOT TELEGRAPH.

The "operator," after informing the audience of the wonderful powers of divination which the subject possesses, introduces the "subject," who is invariably a lady. She is seated on a chair near the front of the stage in plain view of the audience. Her eyes are heavily bandaged, so she cannot see. A committee is invited to go upon the stage to see that the lady has had her eyes properly blindfolded and also ostensibly to help the operator. A large black board is placed at one side of the stage behind the lady. One of the committee is requested to step to this blackboard and write on it with chalk some figures, usually up to four or more decimal places, and after he has done so he resumes his seat. The lady immediately appears to add up the number mentally, calling out the numbers and giving the results of the addition. Each member of the committee is invited to step to the blackboard and touch a figure; no sooner has he done so than the lady calls out the number. Other tests of a similar nature are given, such as the extraction of square and cube root, etc. They all prove that the lady has a thorough knowledge of the numbers on the blackboard and the relative position which they occupy. It is, of course, proved beyond a doubt that the lady cannot see the blackboard. The question then arises, How does she obtain the information? There are two methods of performing this trick. In either case her information is obtained from a confederate, who is generally concealed under the stage, who has the blackboard in sight and who transmits to the lady the desired information.

In one method the lady has a hole 1½ inches in diameter cut out of the sole of one of her slippers. She places this foot over a hole in the stage through which a small piston is worked pneumatically by the assistant. The piston is connected with a rubber tube which runs to where the assistant is concealed. The assistant looks at the blackboard and manipulates the bulb, thus causing the piston rod to strike the sole of the foot, giving signals which can be readily understood by the subject. Robert Heller used a system somewhat similar, only an electro-magnet was used instead of the pneumatic piston.

Another and bolder method of conveying information is the speaking tube. In this case a Vienna bent wood chair is used. The chair is specially prepared for the trick. One leg of the chair is hollow and the air passage is continued to the very top. The lady usually has a long braid of hair hanging down her back, and if not blessed by nature with this hirsute adornment, she wears a wig. In either case concealed in the hair is a rubber tube, one end being close to the ear and the other hanging down with the braid, so that when the lady is seated on the chair the operator can easily connect it with the connecting tube in the chair.



THE SPEAKING TUBE.

*From "Spirit Slate Writing and Kindred Phenomena." By William E. Robinson, assistant to the late Herrmann. New York, 1898. Munn & Company, publishers. 16mo. Pp. 148. 66 illustrations. Cloth. Price $1.00.

The Current Supplement.

The current SUPPLEMENT, No. 1197, is particularly interesting. It contains an article by H. Percy Ashley, entitled "An Up-to-Date Ice Sloop," accompanied by full working drawings for making the same. As the season for winter sports has now arrived, doubtless many of our readers will wish to make an ice-boat of this kind. Mr. Henry Savage Landor's new book, "In the Forbidden Land," is reviewed at considerable length. Mr. Landor entered Tibet by way of India, and was captured by the Tibetans and tortured by them with great cruelty and very nearly killed. He was finally released and allowed to pass over the border. Mr. Landor's narrative is most thrilling, and his adventures rank among the most interesting travels of the latter part of the nineteenth century. The article is accompanied by illustrations from the book showing Mr. Landor being tortured. "Saline Efflorescence of Bricks" is a timely scientific study dealing with the methods by which this discoloration may be prevented. This number of the SUPPLEMENT contains several papers which were presented at the recent meeting of the Society of Naval Architects: "Economy Test of a Unique Form of Feed Pump," by F. Meriam Wheeler; "Stability of a Battleship under Damaged Conditions," by Prof. C. H. Peabody; "Early Marine Engineering in the United States," by C. H. Haswell. "The Recent Eruption of Vesuvius" is illustrated by an engraving made from an actual photograph of the eruption. "Pekin" is an interesting article describing interesting scenes of that city. "Africa and its Animals" is an article by R. Lydekker. "Distilled Water, its Preparation by Simple Automatic and Inexpensive Apparatus and its Preservation," completes this very interesting number. The usual notes are published.

Contents.

(Illustrated articles are marked with an asterisk.)