THE OLD LINE-OF-BATTLE SHIP "PENNSYLVANIA."

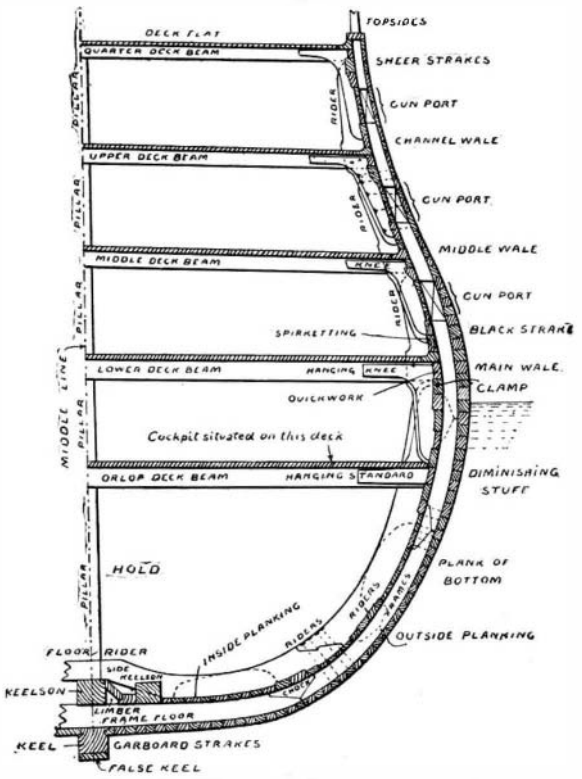
Our sense of the marvelous has been so dulled by the swift-succeeding triumphs of naval science that few of us realize, if we ever stop to think, what prodigious strides have been made in the past half century of warship construction. It is only at such a time as the present, when, with the tumult of battle still in our ears, we turn from the sight of our swiftly moving and destructive modern fleets to the contemplation of the sluggish wooden frigates and three-deckers from which our forefathers fought the enemy, that the full force of the contrast comes home to us. Yet it must be admitted that while in speed, fighting power, and defensive qualities the modern ship of steel is incomparably superior to her wooden prototype, in point of picturesque beauty the older type is beyond comparison.

Of her type and time, the old line-of-battle ship "Pennsylvania," launched after fifteen years of building in Philadelphia, on the sixteenth day of July, 1837, was the grandest example ever built by this government, and, as it turned out, was a luxury too dear for fitting maintenance; for excepting her brief cruise of five days from Philadelphia to sea and into Norfolk, her years of usefulness were spent in performing the prosaic duties of a receiving ship.

The accompanying drawing of this noble ship was made from the original plans on file at the Navy Department; those who are familiar with the subject will agree that it is one of the most successful representations of a three-decker under full sail that has ever appeared. Built of wood throughout, 210 feet in length, 58 feet of beam, with bows as bluff as her seamen's ways; her sides of heavy oak, proof at a mile to her own gun-fire, varying in thickness from 18 inches at the spar deck to 32 inches at the waterline, and pierced upon her four fighting decks by one hundred and twenty smooth-bore, muzzle-loading cannon; with two full acres of canvas spread out aloft on masts that were as long as herself; designed for a complement of over eleven hundred souls—she must, in truth, have been a sight to gladden a sailor's heart as she bowled along under royal stunsails, her bulwarks bristling with cannon, her bulky sides aswell as if with conscious dignity as they bore aloft her tapering masts that towered heavenward glistening with their pyramids of whiteness.

In days when wood was the material of construction, it was no easy task to build the hull of a ship of nearly 5,000 tons displacement which should be capable of mounting a battery of 120 guns, and carrying aloft some two acres of canvas. Although only the best selected oak was used, the various timbers of the hull had to be of enormous size, and the impossibility of securing single sticks of the length required led to an elaborate system of splicing and scarfing, the joints being arranged so that as few as possible would occur in any given section through the vessel.

The accompanying diagram, for which we are indebted to London Engineering, shows the method of construction of Nelson's flagship, the "Victory," on which he lost his life while leading his fleet to victory at the memorable battle of Trafalgar. It is fairly representative of a first-rate of the early part of this century, and gives an impressive idea of the great massing together of timber that was necessary to give the needed strength. Even as it was, the old men-of-war showed structural weakness, frequently hogging at the ends—the old "Victory" herself, now stationed at Portsmouth, England, being fully 12 inches lower at the ends than in the middle. It will be seen that the cross section of the hull, especially of the submerged portion, varies greatly from that of a modern warship. The flat floor extends only about 8 feet on either side of the keel, when the hull begins to round up in a great continuous sweep to the level of the middle deck, the sides having a "tumble-home" of 7 feet from the waterline to the quarter-deck. From the middle deck the contour of the sides is concave. This form above water was discontinued when the era of the steel ships came in; but it has been revived in the French navy, and is seen in a very pronounced form in our own "Iowa" and "Brooklyn."

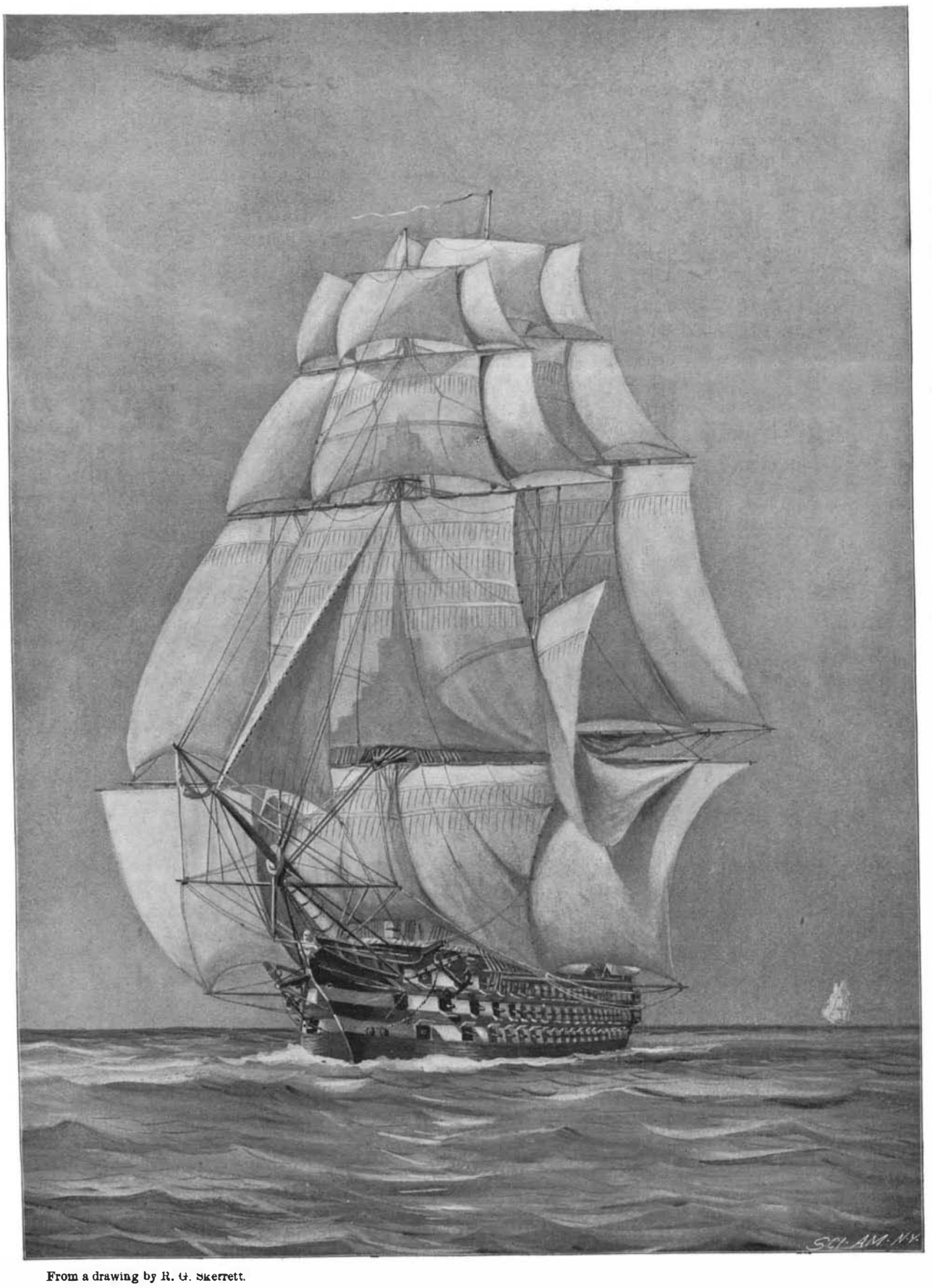


CROSS-SECTION OF A THREE-DECKER.

The keel consisted of massive single timbers 20 inches square, and was laid in as great lengths as were procurable. The frames were 18 inches deep in the floor, 12 inches at the waterline, and 8 inches at the quarter-deck. The hull was double-planked, the outer planking being 6 inches thick on the floor and bilges, from which it increased gradually to 12 inches at the waterline, reducing again to 6 inches at the middle deck, above which it was 4 inches in thickness. The inner planking varied from 4 to 8 inches, the latter being the thickness at the waterline. Upon the inner planking was laid a system of "riders," which varied from 12 to 18 inches in depth, and extended around the interior of the hull, forming a sort of interior framing, adding immensely to the strength and stiffness of the structure. The whole shell of the ship thus laid together was secured by innumerable bolts and treenails, the bolts being from 3 to 4 feet long and passing from the outside planking to the inner face of the riders. The treenails were long oaken pins, which were driven through the frames and both layers of planking, and were secured in place by splitting their ends and driving wedges tightly into them.

The various decks were carried on oak beams which varied in depth from 16 inches on the orlop-deck to 10 inches on the quarter-deck. Support was given to the beams amidships by massive oak pillars, a row of which extended continuously down the center of each deck. At the sides the beams rested upon chocks which were bolted to the frames. The hull was stiffened against distortion or racking in a vertical plane by "hanging knees," massive vertical angle pieces of oak, which were bolted to the beams and to the sides of the hull, and similar stiffening was afforded in the plane of the decks by a system of knees that tied the beams to the sides of the hull and lay flat against the under side of the deck. All the bolts holding the knees to the sides passed through to the outer planking.

There were five decks, named as shown in the



From a drawing by R. G. Skerrett.

THE OLD LINE-OF-BATTLE SHIP "PENNSYLVANIA."

Dimensions: Length, 210 feet; beam, 58 feet; draught, 25½ feet; freeboard, 32 feet; sail spread, over two acres; height of main truck above waterline, 210 feet; width from tip to tip of lower studding sails, 198 feet. **Displacement,** about 4 700 tons. **Maximum Speed,** 12 knots. **Complement,** 1,100 officers and men. **Protection:** Sides, 32 inches oak at waterline, 18 inches at spar deck. **Armament:** Sixteen 8-inch shell and one hundred and four 32-pounder shotguns. Maximum effective range of guns, 2,000 yards. Launched July 16, 1837.

diagram. The battery was disposed in broadside upon the upper, middle, and lower decks, the last named being the strongest deck and devoted to the heaviest guns. The orlop-deck was used as the "cockpit," or operating room, during an action, its location below the waterline rendering it safe from the enemy's shot. It was a dismal quarter, faintly illumined by the light of a few small dead-lights, assisted by the horn lanterns in vogue in those early days.

The guns were mounted on rude wooden carriages, and they were traversed and run up to the firing position by means of rope tackles secured to eyebolts in the deck and sides of the vessel. Solid shot was used against the hull and chain shot against the rigging. At close quarters the guns were usually double or even treble shotted, while grape-shot was used with deadly effect in sweeping the crews away from the guns.

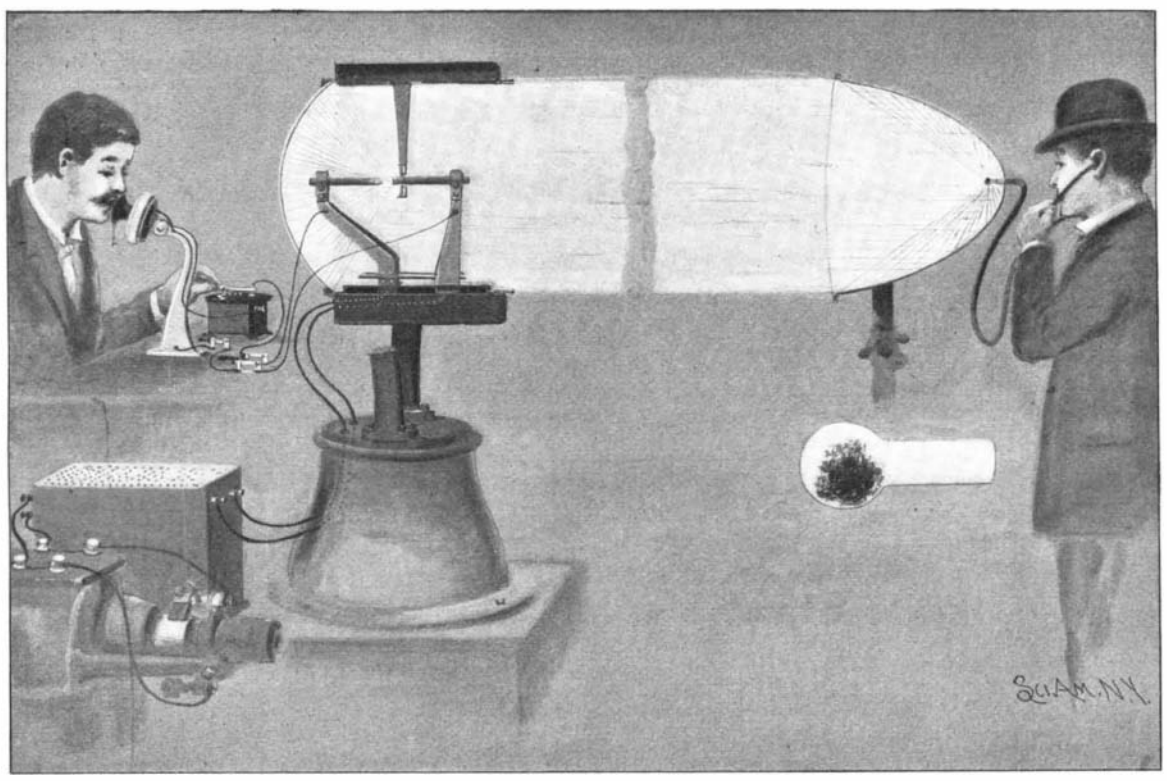
The crowded condition of the decks on ships like the "Pennsylvania," which carried over 1,100 men, involved a frightful carnage when ships were fighting at such close quarters that the muzzles of the guns frequently touched the sides of the enemy's ship. The maneuvering was mainly directed to gaining and keeping the "weather gage" (to windward) of the hostile fleet, and the most destructive work was done with a raking fire. To rake the enemy it was necessary to sail past his bow or stern (preferably the latter) and pour in a broadside down the full length of crowded decks. In some of the most fiercely contested battles a single ship would lose as many as 500 men.

One of the most striking features of the old battleships was their enormous sailspread, the "Pennsylvania" having over two acres at her disposal. The masts and yards were of vast dimensions, such as are never seen in the present day. Not content with yards that were in some of the French ships 120 feet in length, smaller spars, known as stunsail yards, were fitted to slide out in iron rings secured on the ends of the yards and thus extend the stretch of the sails by as much as 70 to 90 feet. The stunsails are shown very clearly in the drawing of the "Pennsylvania."

The great size of her spars may be judged from the following dimensions: The end of the jibboom was 124 feet from the cutwater. From the keel to the main truck was 235 feet, and it was 198 feet from tip to tip of the main studding-sails. The main yard was 110 feet, main topmast yard 82 feet, main topgallant yard 52 feet, and the main royal yard 36 feet in length.

It is impossible to state exactly the power of the old smoothbores of that early day; but probably the 8-inch guns were capable of penetrating about 18 inches of oak at 1,300 yards, and the 32-pounders 24 inches. The maximum effective range was less than 2,000 yards. The rate of fire depended largely upon the rig of the carriage and training of the crew, and it is safe to say that the average fire was not more than one shot per minute.

A NEW and expeditious method for driving piles is described in the instructions as to technical works for the Russian Engineer Corps. On two sides of the pile to be driven are made longitudinal grooves of sufficient width and depth to receive ordinary iron gas pipes of 1 inch or 1½ inches diameter, terminating in nozzles like those of hose pipes, and turned toward the point of the pile, being fixed to it by light staples, while the upper ends are connected by gutta percha pipes with a force pump capable of injecting water under a pressure of five atmospheres—71 pounds per square inch. It is said that the outflow of this water at the point of the pile causes the latter to sink three or four times more quickly than it would under the action of a pile driver. A few blows are, however, given by the monkey when the pile has attained the desired depth, in order to secure the necessary consolidation, and the gas pipes are then drawn out in order to serve for driving another pile.



THE RADIOPHONE—A NEW FORM OF WIRELESS TELEGRAPHY.

THE RADIOPHONE AT THE ELECTRICAL EXHIBITION.

Interest in the electrical show at the Madison Square Garden, in this city, continues unabated. On May 13 the first exhibition of an improved form of wireless telegraphy took place, which attracted considerable attention on account of its novelty and simplicity. It is an apparatus for transmitting varied heat waves in a beam of light to a receiver capable of reproducing the highest sound vibrations with accuracy.

Referring to the illustration representing the way the apparatus is arranged, there will be noticed on the left the generator, next to it a rheostat for adjusting the supply of current to the arc light located inside of a parabolic reflector fixed to project a parallel beam of light in the usual way. A shunt wire runs from each terminal arm of the carbon holder to a knife switch, and from that one wire goes to the base of the usual telephone transmitter arm, while the other is connected to a small resistance box with a regulating switch to adjust the strength of the current to the transmitter. From this resistance box the wire is connected to the other side of the transmitter. Instruments located in this shunt circuit indicated a current of four or five amperes with a voltage between forty and fifty.

When the transmitter is vibrated by the sound of the voice, or of a musical instrument, the current flowing through the shunt circuit varies to correspond, and this varies the main current, passing directly between the carbons. In the focus of the receiving parabolic reflector is placed a glass bulb holding a small quantity of carbonized filament (this will be seen enlarged at right of the picture). From this bulb a tube runs through the back of the reflector and is connected by a rubber tubing to small ear phonograph tubes.

At the time we heard it a cornet was playing in front of the transmitter; the notes came out clear and distinct in the parabolic receiver about 350 feet distant, and about one-third as strong in volume as the sound heard in the ordinary electric telephone receiver. The fluctuation of the temperature of the fiber in the bulb due to the variable impinging heat waves causes like fluctuations of the volume of air in the bulb which acts upon the drum of the ear. The light is only projected for brief intervals at a time, as a continuous heating of the carbonized fiber reduces the sound. The instruments are placed in the regulation telephone booths, one side of the booth being partly open to allow the electric light beam to freely pass. It is said that signals and speech have been transmitted a distance of two miles, from a vessel to the shore, by means of larger and more powerful searchlights.

New Port for Montevideo.

The Hon. W. R. Finch, United States Minister to Paraguay and Uruguay, informs us that a contract for building a new port at Montevideo for Uruguay is to be given out. The amount of money required to complete the job will not be far from $10,000,000, and he believes the government of Uruguay will give American capitalists and contractors more than an equal chance of obtaining the contract for building a port. Contractors may communicate with him at Montevideo, and the information as to what is required is also on file at the State Department at Washington.

A SNAKE-INFESTED REGION IN OREGON.

ANIMAL COMMUNITIES.

BY C. F. HOLDER.

The schooling, swarming, herding or flocking of animals presents a fascinating subject, and the causes which govern the various movements constitute an elaborate study. Recently the writer while duck shooting in a California tule swamp became so interested in the flocking of birds that he forgot the ducks. Before the blind extended hundreds of acres of tule swamp which resounded with the notes of the blackbirds. As the sun rose, there was a concerted movement among the birds, and as near as could be judged from five hundred to one thousand birds would rise, as though a signal had been sounded, and sweep on, filling the air with their sounds, then as suddenly drop into the tules on the edge of the swamp. This appeared to be the rendezvous, as though some general officer was appointing the birds to certain farms and ranches for the day, as from this spot other divisions, each composed of hundreds, rose as one bird, flying off in different directions—a proceeding which was kept up for several hours until every ranch within five miles must have received its flock of red-winged blackbirds.

Many of the birds appear to form in flocks at the time of migration. The Pacific brown pelican is prone to fly in flocks of from ten to fifty, while its cousin of the Gulf of Mexico is to some extent a solitary bird.

Among the fishes the swarming or schooling is particularly noticeable. The herrings, sardines and their allies are always banded together, in all probability for mutual support, and the study of a school is an interesting pastime. The fishes seem governed by some one impulse, and the greatest order is preserved; the school hurrying up, down, or to the side as a single fish. Yet this schooling is often their undoing. The writer has seen a small seal so intimidate a