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."

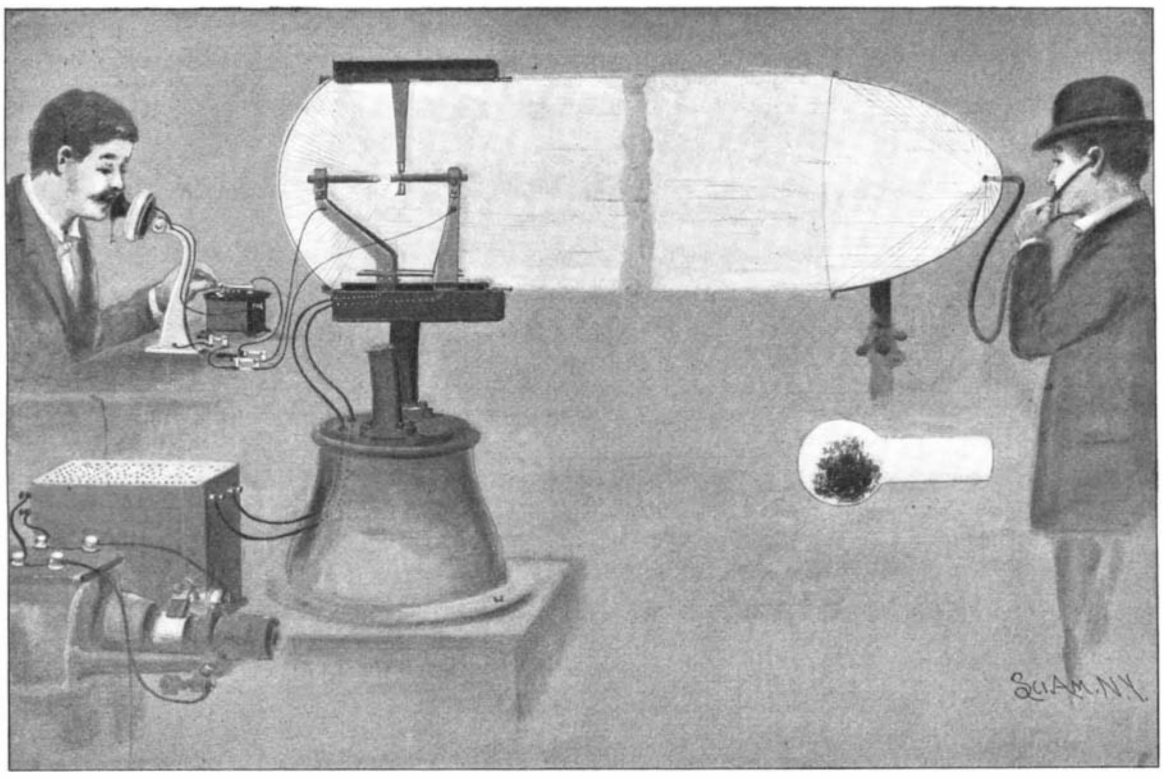
The great size of her spars may be judged from the following dimensions: The end of the jibboom was 124 feet from the cutwater. From the keel to the main truck was 235 feet, and it was 198 feet from tip to tip of the main studding-sails. The main yard was 110 feet, main topmast yard 82 feet, main topgallant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



THE RADIOPHONE—A NEW FORM OF WIRELESS TELEGRAPHY.

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.

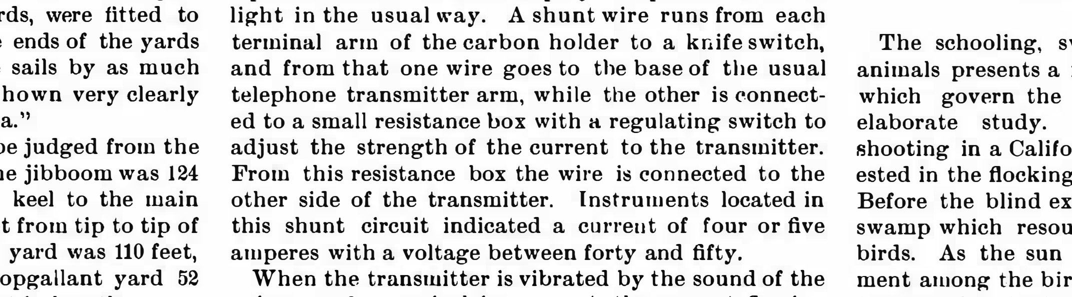
New Port for Montevideo.

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.

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.



A SNAKE-INFESTED REGION IN OREGON.

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 large school that they were concentrated into a ball of living fish not ten feet across. The seal swam around them with great velocity, preventing their escape, occasionally dashing into them with wide-open mouth.

The California barracuda is always found in schools, filling the water for acres. The Gulf of Mexico species is a solitary fish. In the Pacific the yellow-tail schools often cover the water for acres, then breaking up into pairs or trios. So with the horse mackerel; thousands frequently being found schooling.

Among the mammals the collection of vast numbers is best illustrated by the American bison, which was, and which now, owing to the most outrageous vandalism ever perpetrated in a civilized land, is almost extinct. The bison fairly covered miles of country, presenting a marvelous sight.

The most extraordinary collection of animals to be seen in America are the fur seals which gather at the Pribylov Islands in spring, at the breeding season, later going to sea, and south in February and March, as far as the Santa Barbara Islands, several having been observed at Santa Catalina during the present year, a sea migration of many hundred miles being taken each year.

A very similar movement is seen among the penguins of the South Pacific islands. At times what is supposed to be millions of birds are found on the islands; later they disappear completely, making an ocean trip to some unknown land or sea for unknown purposes and reasons.

This herding or collecting of large numbers is not so common among reptiles, though in certain localities, as illustrated by the accompanying photograph, snakes congregate in large numbers. In Montana a singular cleft in the rocks has been famous for years for the snakes of all kinds which seem to have chosen it as a home. It is of unknown depth, and so snake-infested that no one has had the temerity to probe its interior. Yet every fall quantities of snakes from long distances away have been seen proceeding in this direction, finally entering the hole in the ground, recognizing the place and location as a favorite one for winter hibernation. At the time of these gatherings the place presents a sight that might have been the inspiration of Dante in some of his weird conceptions, the rocks being literally covered with snakes.

More remarkable still for its myriads of snakes is the region about Klamath Falls, Oregon. The writer is indebted to Mr. Castle, the postmaster of the town, for the photograph, which he states does not do justice to the actual condition of affairs, showing, as it does, but a small section of the snake-infested region. The town stands upon the bank or near a little river which for some reason has an attraction for these snakes or is peculiarly adapted to their requirements. Possibly birds which prey upon the snakes are for some reason scarce at this point, and the reptiles have had no interruption for years. Be this as it may, whatever may be the cause, the land along the river front is without exaggeration fairly alive with snakes that are heaped one upon the other, in groups, singly, in rows, lines and masses. One might well believe that the forms shown in the accompanying illustration were cunningly arranged to convey the idea of numbers; but they were photographed as they were found, and Mr. Castle informed the writer that by selecting a place later in the season many more could be shown.

The snakes hibernate here through the winter in holes and crevices adjoining the river bank, and in obedience to the warm sun of spring crawl out and bask in its rays; covering the ground with their sluggish forms and presenting a scene so remarkable in its entirety that it might well be considered the result of a distorted imagination. The snakes, fortunately, are perfectly harmless, and make little or no demonstration when approached, paying no attention to the photographer.

An Invention Wanted to Utilize Fog.

Mr. Herbert Earlscliffe, of Santa Barbara, Cal., has communicated to the Weather Bureau, through the Chamber of Commerce of Los Angeles, a suggestion relative to fog that should call forth all the inventive genius of America. Mr. Earlscliffe says:

"In California there are vast areas of valuable land where the water supply is insufficient. Nature has endeavored to correct this by sending in heavy fogs laden with moisture, and it only remains for the ingenuity of man to utilize this. These fogs generally come in from the ocean at night during the dry summer months, when most needed, but are dissipated early in the morning by the sun. Here is ample moisture brought to our very doors if we could but discover some simple and practical method of condensing or precipitating it on a large scale."

It certainly is tantalizing to think of this immense quantity of moisture present and visible but unavailable. Neither science nor art, at present, can suggest any feasible method of causing this fog to descend in refreshing drops of rain. On the other hand, the green vegetation at the summits of many mountains has often been observed to be due essentially to cloud or fog and not to rain; it may, therefore, be hoped that along the coast of California some device will soon be introduced that shall catch the fog particles as they float along and force them to trickle down in gentle streams of water so as to moisten the earth. We do not propose to condense or precipitate the atmospheric moisture in the ordinary sense of those words, but simply to catch it as the leaves of the trees do. We recall the so called drip from every rock and twig on the summit of Table Mountain at Cape Town, and especially on the summit of Green Mountain in the island of Ascension, and the dampness of the rocks on Pike's Peak, and we cannot doubt but that in many spots throughout the globe vegetation is kept alive by the small amount of moisture that is caught on the leaves, and dripping thence to the ground is soaked up by the roots of the plant. In fact, there are several plants whose leaves and branches are so arranged as to facilitate drip and the collection of moisture by this process. What is needed by the agriculturist on the California coast is some simple mechanical arrangement by which the quantity of fog particles shall be intercepted as they flow past any given plant, and shall be forced to drip or glide downward into the ground at the root of the plant. Any fan-shaped arrangement of sticks or slats that increases the area exposed to the fog should apparently increase the quantity of moisture carried down to the roots. Mechanical devices, the explosion of dynamite, refrigerating apparatus, and other analogous devices are likely to be too expensive in comparison with the return they make.—Monthly Weather Review.

Some German Acetylene Statistics.

Two of the German acetylene journals have become interested in the statistical side of that industry, and have collected and published considerable data upon the subject. One of these journals, Das Acetylen (February 25), sent out 52 blanks and received 37 answers, from which, with collateral information, the following figures were derived.

In 1898, in the German acetylene apparatus shops, there was sold:

Generators	6,451
Burner capacity of each generator	1 to 300
Total burner capacity	112,355
Candle power of burners in Hefner candles	10 to 60
Candle power of burners in Hefner candles, total	3,182,100
Average burner capacity of generator	17
Average candle power of burner in Hefner candles	28

The demand was greatest for apparatus having a capacity of 15 to 30 burners.

Upon the basis that the generation of one Hefner candle (0·888 English candle) requires 0·0265 cubic feet of acetylene, the above capacity of 3,182,100 candles would require the consumption of 84,325 cubic feet of acetylene. If one pound of carbide generates 4·8 cubic feet of gas, there was therefore required a supply of 17,567 pounds of carbide per hour, or, on a basis of a yield of 4·46 cubic feet per pound, an hourly consumption of 19,000 pounds of carbide. Counting 1,900 burning hours per year, the yearly demand for carbide was respectively 16,688 and 18,050 short tons. Taking the price of carbide at 4 cents per pound, or $80 per ton, we see that the sales must have aggregated, for 16,688 tons consumption, about $1,335,040; this sum doubles itself when we consider that but about half the German and Swiss production of carbide is used in these countries, and therefore that at least $2,770,000 worth of carbide was turned out during 1898.

Generators having a capacity of 25 burners are most in demand, and most of this size are sold. The average price being $125, and 6,451 of these being sold, would bring the total up to $806,375. Calculating that one burner costs 25 cents, the 112,355 burners going with these generators will cost $28,089. The carbide works and acetylene apparatus manufacturers in Germany therefore did a business in 1898 amounting to $3,604,464.

The nine largest acetylene firms in Germany have a capital of $1,122,500; and the smaller firms, having a capital under $25,000 each, will agregate $153,750, making a grand total of $1,276,250. There are 1,020 men employed in the shops.

The practice seems to be to make the distribution pipes not so strong as ordinary city gas pipes above 1·5 inches diameter, and to have them with but one-third the cross-sectional area for the same service. The valves and fixtures are made of brass, red castings (75 to 80 per cent copper), white metal and iron; practice has shown that the fear formerly existing as to the formation of explosive acetylides of copper has no foundation.

For generator construction, with few exceptions, leaded iron is used, the plates being from 0·63 to 0·016 inch in thickness (Nos. 10 to 12); in one case, a pressure generator, the walls were from 0·23 to 0·58 inch thick. One firm reported the following weight of plate used: 15 flame generators, 0·039 inch; 30 flame, 0·058 inch; 100 flame, 0·078 inch; 150 flame, 0·117 inch; above this, 0·156 to 0·175 inch. Another firm does not go below 0·058 inch plates even for three to six flame generators. All firms offer the forked burner, some entirely of steatite, and others with steatite heads only, and either angular or of horseshoe shape. In answer to the query as to how many feet of pipe had been laid, seven firms answered that they had put in 533,000 feet of from ¼ to 8 inch pipe.

THE EFFICIENCY OF THE BICYCLE.*

The object of this paper is to call attention to a few interesting points in connection with the efficiency of the bicycle.

In the present investigation no attempt has been made to treat the bicycle under road conditions, but simply as a machine; and the efficiency tests therefore have been conducted along the same lines and with practically the same apparatus as that used by Mr. Mack, and described in his paper before the American Society of Mechanical Engineers.

The apparatus, as shown by the photograph, consists of a 10-inch I beam, 15 feet long, planed smooth on top, mounted at a convenient height and carefully leveled.

At one end of the beam is fixed a pulley, over which runs a piece of indicator cord carrying a scale pan and attached by wires to the rear axle of the wheel. Suspended from the seat post is a frame made of ordinary inch pipe and carrying a shelf 3 feet long. This shelf is placed a sufficient distance below the beam to insure the perfect balance of the wheel when a load of 150 pounds (representing the weight of the average rider) is placed upon it.

The bicycle is now used as a hoisting machine, known weights placed in the scale pan at the rear of the machine being raised by placing other weights in the pan attached to the pedal. These latter weights, which drive the wheel forward through a short distance, are taken from the shelf, thus keeping the total load on the wheel constant. As weights are transferred to the pedal pan the balance of the wheel is maintained by adjusting the remaining weights on the shelf.

As the effective radius of the crank varies very slightly for a distance of some ten degrees on each side of the horizontal, it may be assumed as practically constant during this portion of a rotation.

The apparatus thus represents a rider, weighing 150 pounds, sitting upright and gradually throwing his weight from the seat to the pedal, in order to propel the machine.

The total efficiency of the wheel is now determined by ascertaining the energy expended in one revolution of the pedal and the corresponding work done in lifting the weight drawn over the pulley at the rear. The difference between the two must be due to the friction of the intervening parts of the machine.

If B equals the circumference described by the center of the pedal pin and P equals weight on the pedal, then $B\ P$ equals the energy in inch-pounds expended in one rotation of the pedal pin.

If R equals ratio of large to small sprocket and A equals circumference of tire, then $R\ A$ equals distance passed through by the machine for one revolution of the pedal pin.

Letting M equal the resistance overcome, which would equal the weight placed on the pan at the rear of the machine, divided by the efficiency of the pulley, then $M\ R\ A$ would equal the actual work accomplished.

The efficiency would be determined by the fraction

$$\frac{M\,R\,A}{B\,P}$$

Fig. 1 shows the results obtained from two wheels of the same make and grade, these particular curves being chosen as they give practically the same maximum efficiencies.

The full line is the efficiency curve of the chainless wheel, and the broken line of the corresponding chain wheel.

Fig. 2 shows some very interesting facts. The upper or full line curve shows the results obtained from a special racing wheel gotten out for the use of a man riding for the company. It was understood that the bearings were specially ground, and everything done to make the wheel represent the best possible conditions. It was very light in construction, and carried 1⅜-inch tires. The wheel had been ridden only a few hundred miles, and before being tested was specially cleaned and oiled.

In a test of a $50 and a $75 wheel, both from the same factory, and in the best possible condition, the $75 wheel showed a higher efficiency by about 7 to 10 per cent.

A wheel of high grade taken direct from the factory in which the sprocket wheels and chain were apparently rough in finish, gave a very irregular efficiency, which was far from satisfactory. After having the wheel ridden a few hundred miles it was again placed upon the testing machine, and showed from 5 to 10 per cent higher efficiency.

Another test was made on a wheel representing the best practice in bicycle construction and method of protecting bearings, after it had been exposed for some time to the rain. The wheel was frequently left lying out in the rain for hours, and received no care. The curve showed a remarkable efficiency, and, while the average was far lower than that of the corresponding wheel in good condition, yet it would indicate that the

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