same, the "Sardegna," of 13,860 tons and 20 knots, being slightly the largest and fastest. In the arrangement of their armament the central redoubt has been abandoned and the system of two separate fore and aft main gun positions, with a central rapid-fire battery amidships, adopted. This arrangement was first used in the "Admiral" class of the British navy, and is now adopted universally in the navies of the world. As compared with the "Andrea Doria," the belt armor has been reduced from 17·7 inches to 4 inches, and it covers about two-thirds of the length amidships, extending to the main deck. The barbettes project above this deck to a height of about 13 feet, the axis of the main 13½-inch guns being about 26 feet above the waterline. This gives a good command, but the seagoing qualities of these fine ships would have been greatly improved if the amidships superstructure deck had been carried out to the bow as in our own "Alabama" and "Maine" classes. The 13½-inch gun weighs 68 tons, and fires a 1,250-pound projectile with a muzzle energy of 35,230 foot-tons and a muzzle penetration of 33 inches of iron. The amidships rapid-fire battery of these ships is unusually powerful, consisting of twelve 4·7-inch guns on the main deck, eight 6-inch guns on the superstructure deck, and four 4·7-inch guns on the bridges, two forward and two aft. None of this battery, however, has more than shield protection, and its formidable character is modified by the meager character of the side armor. Strictly speaking, these ships belong to the armored cruiser class, for they could never lie in line of battle against well protected battleships with much hope of success.

The faults of the "Re Umberto" are corrected in the "St. Bon" and "Emmanuele Filibert," launched in 1897, in which, on the small displacement of 9,800 tons, the Italians have secured the following admirable qualities; a complete Harveyized belt tapering from 9¾ inches amidships to 4 inches at the ends; a belt above this of 6-inch armor extending to the main deck and covering the sides between the barbettes; two 9¾-inch turrets protecting a main battery of four 10-inch guns, and a continuous wall of 6-inch steel surrounding a central battery of eight 6 inch rapid-fire guns on the main deck; eight 4·7-inch guns protected by shields, carried on the superstructure, and twenty-four smaller rapid-fire guns. The speed is 18 knots and the normal coal supply 1,000 tons. Although she is 50 per cent smaller, the "St. Bon" would prove more than a match for the "Re Umberto."

The latest Italian ideas of battleship construction are shown in the "Benedetto Brin" class, which at present includes two ships of 12,765 tons displacement and the unprecedented battleship speed of 21 knots. The "Benedetto Brin" is being built at Castellamare and the sister ship, "Regina Margherita," at Venice. The particulars are as follows: An armor belt 6 inches thick amidships tapering to 2 inches at the ends and reaching from the bow nearly to the stern. Above this a 6-inch belt extending between the barbettes and connected by transverse bulkheads which inclose the bases of the barbettes. This upper belt reaches to the spar deck and thus provides a complete central redoubt of 6-inch armor. The barbettes are protected by 10-inch armor and each contains a pair of 12-inch breech-loading rifles. The after barbette is carried on the main deck, and on the same deck, within the central citadel, is a rapid-fire battery of twelve 6-inch guns mounted in broadside. On the spar deck above, at each corner of the casemate, is a turret protected by 6-inch armor, carrying an 8-inch rapid-fire gun, and forward on the same deck is mounted the forward pair of 12-inch rifles. Ten 3-inch and six 1·8-inch guns are carried on the superstructure and bridges. It is evident that the high speed and powerful armament of these ships must have been gained at the expense of the defensive powers. This is best shown by a comparison of this vessel with the "Maine" of our own navy, which is of about the same displacement.

	"Maine."	"Benedetto Brin."
Length	388 feet.	413 feet.
Displacement	12,500 tons.	12,765 tons.
Speed	18 knots.	21 knots.
Coal supply	1,000 tons, normal.	1,600 tons, normal.
Belt armor	12-inch maximum.	6-inch maximum.
Citadel armor	7-inch.	6-inch.
Barbette armor	12-inch maximum.	10-inch maximum.
Main battery	Four 12-inch.	Four 12-inch.
Intermediate battery	None.	Four 8-inch rapid-fire.
Secondary battery	Sixteen 6-inch, twenty 6-prs., six 1-prs.	Twelve 6-inch, ten 12-prs., six 3-prs.

The adjoining table shows that while the armament of the Italian ship is far more powerful than that of the "Maine"—the difference being due to the rapid-fire 8-inch guns—the "Maine" is much better protected, the belt being 100 per cent thicker and the barbette protection 12 inches as against 10 inches. We greatly regret that the "Alabama" and "Maine" classes do not carry any 8-inch guns. This weapon has been particularly identified with United States warships; it proved to be the most effective of all the guns in use at Santiago and Manila; and ever since Armstrong showed the practicability of applying the rapid-fire mechanism to it, its destructive powers have been enormously increased. The four 8-inch guns of the "Benedetto Brin," with their high command of 28 feet and their good protection, would give the Italian vessel a marked theoretical advantage in an artillery duel with the "Maine." The 12-pounders and 3-pounders of the "Brin" are preferable to the 6 and 1-pounders of the "Maine."

We place particular stress upon these points in the hope that before the contracts are let for our new 13,500-ton battleships, authorized by the last Congress, such changes may be made as will admit of the reintroduction of the 8-inch gun and the substitution of the 12 and 3-pounders for the 6 and 1-pounders. The use of Krupp in place of Harvey armor (supposing Congress desists from its obstructionist policy in the matter) would greatly reduce the total weight of the armor and compensate for the added weight of the 8-inch guns, mounts, and ammunition.

COAST DEFENSE VESSELS.—The Italian navy is but poorly provided with coast defense vessels pure and simple. Like Great Britain, she favors an aggressive policy, placing her floating armaments in large ships of good speed and sea-keeping qualities. Moreover, her principal strategic points are well protected by fixed fortifications. The coast defense type is represented by five small armored vessels that were built over a quarter of a century ago. They are the "Affondatore" (4,062 tons), built at Millwall, London; and the "Ancona" (4,460 tons), the "Castelfidorio," "Maria Pia," and "San Martino" (4,260 tons), built in France. The first named has a 5-inch belt and carries two 28-ton Armstrong guns and six 4·7-inch rapid-firers; the other four have 4½-inch belts and are armed with six 6-inch and six 4·7-inch rapid-fire guns. The speed of all five vessels is 12 knots, and the complement from 300 to 400 men.

ARMORED CRUISERS.—At the opening of the present year there were five armored cruisers built or building for the Italian navy. The most important of these vessels are the twin ships "Vettor Pisani" and "Carlo Alberto," of 6,500 tons, and the "Varese" and "Guiseppe Garibaldi," of 7,400 tons displacement. These very fine ships are modifications of the "Christobal Colon," which was originally laid down at Sestri Ponente for the Italian navy, but was sold to Spain before her completion. They are all distinguished by their unusual protection, which consists of a complete 6-inch belt, a central citadel of 6-inch armor extending over two-thirds of the length, and from the belt to the main deck, and an armored deck. The speed is 20 knots in case of all four ships, and the maximum coal supply is 1,200 tons. The "Vettor Pisani" and her mate carry eighteen guns of the large rapid-fire type distributed as follows: Eight 6-inch on the gun deck in broadside and four 6-inch on the main deck within the citadel, the latter having a dead ahead and dead astern fire; four 4·7-inch on the main deck, between the 6-inch guns; one 4·7-inch on the same deck in the bow and one 4·7-inch in the stern. There are also twenty-two 12 and 3-pounders. The "Varese" and "Garibaldi" have the same armor, speed, etc., but the armament consists of one 10-inch gun forward in a barbette, two 8-inch rapid-fire guns aft in a barbette, ten 6-inch rapid-fire guns in the gun deck battery, and four 6-inch rapid-fire guns at the angles of the main deck battery.

These two ships have a greater energy of gun-fire per minute than any ship built or building in the world to-day; the total being greater even than that of the German "Fürst Bismarck" of 10,482 tons, or the British "Cressy" of 12,000 tons.

The "Marco Polo" is a smaller vessel, of 4,583 tons and 19 knots, whose particulars are given beneath the accompanying cut of the ship. The battery is entirely of the rapid-fire type and is characteristically powerful. The six 6-inch guns are carried, one forward on the forecastle deck, one aft on the poop, and four on the main deck at the break of the forecastle and quarter decks. The ten 4·7-inch guns are all on the main deck, two beneath the forecastle deck, two beneath the poop, and six amidships between the 6-inch guns. In appearance and distribution of armament the armored "Marco Polo" resembles our own protected "New Orleans."

PROTECTED CRUISERS.—The strength of the Italian navy lies in its armored vessels, and in this respect it resembles the Russian navy. What protected ships Italy has built have been small, none of them exceeding 3,600 tons displacement. Of vessels of this class, between 2,000 and 4,000 tons in displacement, there are seventeen, with an average speed of 18 knots, an average displacement of 2,754 tons, and a total displacement of 46,818 tons. There are also twenty-eight small cruisers and gunboats of an average displacement of 886 tons and an average speed of 17·9 knots. None of these vessels call for special remark, unless it be the "Piemonte," of 2,500 tons, built in 1888 at Armstrong's, which was the first warship to be armed with rapid-fire guns. In this respect, and in respect of her at that time unprecedented speed of 21 knots, she is an epoch-marking ship.

We illustrate a typical vessel of each class above mentioned. The "Etruria" is one of three ships built in Italy, between 1890 and 1893. They are 220 tons smaller than the "Piemonte," and carry four 5·9-inch and six 4·7-inch rapid-firers as against six 6-inch and six 4·7-inch rapid-firers. The speed is from 2 to 3 knots less, the deck 2 inches against 3 inches, and they carry 400 against 560 tons of coal. The majority of the protected cruisers are of modern construction, and, as a class, they should prove to be serviceable vessels.

In conclusion, it must be admitted that there has been so much variety, so much experimental designing, in the Italian fleet that only the actual test of war can settle the actual fighting value of its first line of battle. Judged by current ideas, the battleships of the "Duilio," "Andrea Doria" and "Italia" classes are hampered by a slow and cumbersome though admittedly powerful armament, while the "Italia" and "Re Umberto" classes are perilously deficient in defensive qualities other than those which accrue from ability to run away—and the Santiago tragedy would indicate that the latter is an expedient of very doubtful value, to say the least. It is in her armored cruisers, of which it is difficult to say too much in praise, that Italian naval architects have scored their greatest success, and it is not unlikely that the original cruiser-battleship "Christobal Colon" will prove to be the prototype of the standard fighting ship of the future.

Novel Switch for Electric Cars.

Mr. Hiram Stevens Maxim has lately patented a new means of operating the switches of electric cars. It is well known that, in order to get quick acceleration, it is necessary that practically the whole weight of the train should rest on the drivers. It is therefore necessary to provide each car with a motor, and when several cars are coupled together in a train, as they will have to be on the Underground in London, it will be necessary to have a man to each car, or to have some device by which the driver of the front car can control the switches of the entire train, and various devices have been thought out and patented for this purpose.

These all require some connection between the various cars other than the coupling, but by Mr. Maxim's method the drawbar of each car is attached to the switch in such a manner that the switch is operated by the tendency of each particular car to pull back as relates to the drawbar. The drawbar of each car is an inextensible rod running the whole length of the car, with a coupling at each end. This rod is held in a central position by two spiral springs, and is connected to the switching device of the car in such a manner that, no matter in which direction the bar is moved as relates to the car, it switches in the current which moves the car in the same direction. Therefore, each car follows the drawbar automatically, and the motor of each car does just sufficient work to propel that particular car. This device is of great simplicity and is easily understood, as it requires no coupling or connection between the various cars of the train except the coupling itself.

THE BIRD GIANTS.

BY CHARLES FREDERICK HOLDER.

Among the big things which the State of California produces are ostriches. It has been found that the mild climate of Southern California is remarkably well adapted for the purpose, and that ostriches breed and thrive as well here as in their native African haunts. The experiment was first tried by an Englishman, Mr. Edwin Cawston, who, in 1885, bought fifty-two birds in South Africa. It was a hazardous experiment, as the big birds are extremely difficult and dangerous to handle; but forty-two were landed on American soil. From these pioneers the fine ostrich farm at Pasadena, Cal., has grown, which at present contains two hundred birds. Here one can study the history of these birds from the egg to the adult; and as the industry is now protected by an import duty of 20 per cent, the ostrich farm is on a sure financial basis and has become one of the paying American industries.

The Pasadena ostrich farm is beautifully situated among a grove of live oaks on the Arroyo Seco, between the cities of Pasadena and Los Angeles. The inclosure of several acres is divided into corrals in which the various classes of birds are seen. As we enter, the birds approach in droves with a queer mincing gait, ludicrous in the extreme. The ostrich impresses one as being the type of stupidity, posing as a very wise personage; its large body, small head and brain, constructed on economical principles, its enormous eyes, all carrying out the idea.

The birds are fearless and approach visitors, taking food from their hands. The correct thing to do seems to be to feed oranges, which are devoured whole, the diversion being mutual, as the orange presents a remarkable appearance as it passes down the long neck of the bird. The keeper, who tells us that he was once nearly killed by a bird, is a fund of information, and from him we learn all the secrets of running an ostrich farm. First, one must have the birds, which cost from one thousand dollars upward apiece in Africa; but, as they breed when they are three years old, there is a quick return.

There is a definite arrangement in the corrals. The best-feathered are selected and paired, space being left between the males, which fight and often kill one an

other. During the laying time, it is often dangerous to approach them, the males rushing to the attack, and, by a forward downward kick, producing a serious wound, often fatal. Horses and even men have been killed; and when the charge is made, the keepers find safety by lying flat on the ground.

The adult birds are magnificent creatures, standing seven feet high and weighing two hundred and fifty pounds. One of the interesting sights is to see them feed. They literally eat anything, according to the keeper, but are maintained on alfalfa. Among the extraordinary things that have been snatched from the hands of visitors and others and swallowed are nails, a gimlet, lighted pipes, a rolled newspaper. The writer once saw an ostrich snatch a bonnet from a lady's head and swallow it; but in this case a green veil that was the bonne-bouche caused the animal's death. With their food of alfalfa and vegetables, the birds are provided with broken shell for the lime, and quantities of pebbles, which they swallow to aid in grinding the food.

The breeding season, at which time we are fortunate in making our visit, is in early spring. The male bird now becomes very active and ugly. He rests his breast bone on the ground at some selected spot, and with his powerful claws throws the dirt away, turning round and round during the operation, until a shallow hole is the result, by courtesy a nest. In this work the female sometimes joins. When it is complete, the hen takes her place and lays an egg every other day. And what an egg it is! One would make an omelet for thirty men with moderate appetites, as one weighs three pounds and is equal to thirty hen's eggs. When twelve or fourteen eggs have been deposited, the birds scatter a little sand over them and begin the labor of hatching them, dividing their time with almost mathematical precision, and presenting a remarkable instance of the sense of responsibility in both male and female. The male takes his place at four o'clock in the afternoon and covers the eggs. At nine o'clock in the morning he is relieved with all the promptness of a sentinel by the female; and it is an interesting point to notice that at noon, though the male is off duty, he relieves the female for an hour, allowing her to take a rest and obtain food. This can be seen by every one, as the nests are in the open corral, and nesting carried on for nearly six weeks.

If one could approach the eggs now in the absence of both birds, a curious tapping would be heard on the shells, called "telephoning" by the keeper. In a word, the chicks have arrived and are knocking for admission into the world. Some succeed in breaking out; others have to be assisted, and the hen will press gently upon them at such times and break the shell; then she will take the youngster in her bill and pick it out, shaking the bits of shell from it.

The baby birds are most attractive little creatures, covered with wiry, hairlike feathers and possessed of the greatest curiosity. They are at once taken from the parents and brought up by hand in nurseries especially arranged for baby ostriches. They are turned into a field of alfalfa during the day and at night kept in warm boxes or artificial mothers. For two or three days they do not seem to care to eat. Then they eat stones and bone crushed, and on the fifth day alfalfa, from now on growing rapidly, so that at the age of six months they are six feet high, having grown at a rate of a foot a month; after this the growth is slower.

The reason for taking the young from the mother is a purely business one, as the birds immediately build another nest, which they would not do if the young were left with them to rear; so instead of one brood a year the owner obtains seventy or eighty eggs from a single bird. In six weeks the chicks are tall and robust birds, beautifully spotted and rapidly becoming valuable commodities. At a year old they are valued at $150 per pair; chicks three to six weeks old, $40 a pair; while the full grown bird is valued at $300 per pair. It is evident then that the ostrich is within the reach of the average individual; yet there are some drawbacks, as an ordinary ostrich has an appetite that, apparently, has no limitations, and one will literally eat a poor man out of house and home.

The birds are valued for their feathers, for which there is a growing demand, and if the visitor is present at the farm during what is termed the "picking," he or she is well repaid. The full-feathered bird is a beautiful creature, but every feather is not valuable or a plume. The feathers are of many kinds and differ widely. In the very young birds they are yellow and white, later dark drab on the male, black and white in the female. The fine plumes are found on the adult male and to bring the best price should be taken from the living bird, those from the wing being the most esteemed, especially the so-called ivory-colored plumes.

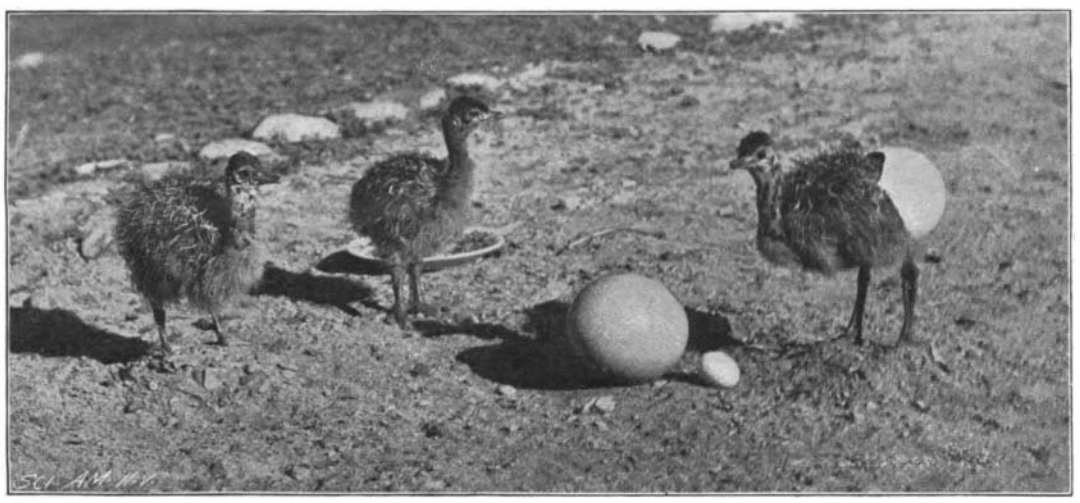
The picking of the feather crop occurs every few months, the occasion being not only interesting but exciting, as the birds protest decidedly to the robbery. The pickers are men skilled in the business; necessarily so, as poor picking ruins feathers and birds. When picked, the feathers are what is termed ripe; that is, they would soon be thrown off by the moulting process, consequently there is little or no pain in the operation. The heavy plumes are cut off, the stumps being removed three months later.

At this picking time the birds are separated and driven into a narrow pen, their heads being covered with a perforated bag. The men station themselves behind, so that the bird cannot kick, and holding it securely the picking is performed in view of the large audience that usually collects at this time. Three crops of feathers are obtained in about two years, each bird being estimated to produce $30 per year in feathers; and as each bird attains an age of from fifty to even seventy years, the profit of feathers alone is enormous, not to count the young. As the feathers are collected they are classified and placed in bags: those of the males in one, those of the females in another, as all have some peculiar market value, and the grades are well recognized by the trade. When graded and weighed, they go to the expert feather dressers of Los Angeles, San Francisco, and New York. Here they are tied on strings four feet in length, or in bunches, classified thoroughly, and are then sent to the dyer, as no matter whether the feather is naturally black it is dyed black. After this they are washed in water and starch; the latter is then removed when they are ready for the "finisher," where they are graded, assorted, sewed together, often three or five pieces to make one plume; they are then steamed to allow the fibers to take their natural position. The curler now takes them, and gives the plume the graceful shape so desired. From the hands of the curler they pass to the man called the "buncher," who combs them out and gives them the particular shape demanded by fashion. Now the plume or feather is ready for the market and is placed on sale. The history of the feather from the hatching of the young ostrich to the beautiful plume on the hat of some lady is a long and complicated one.

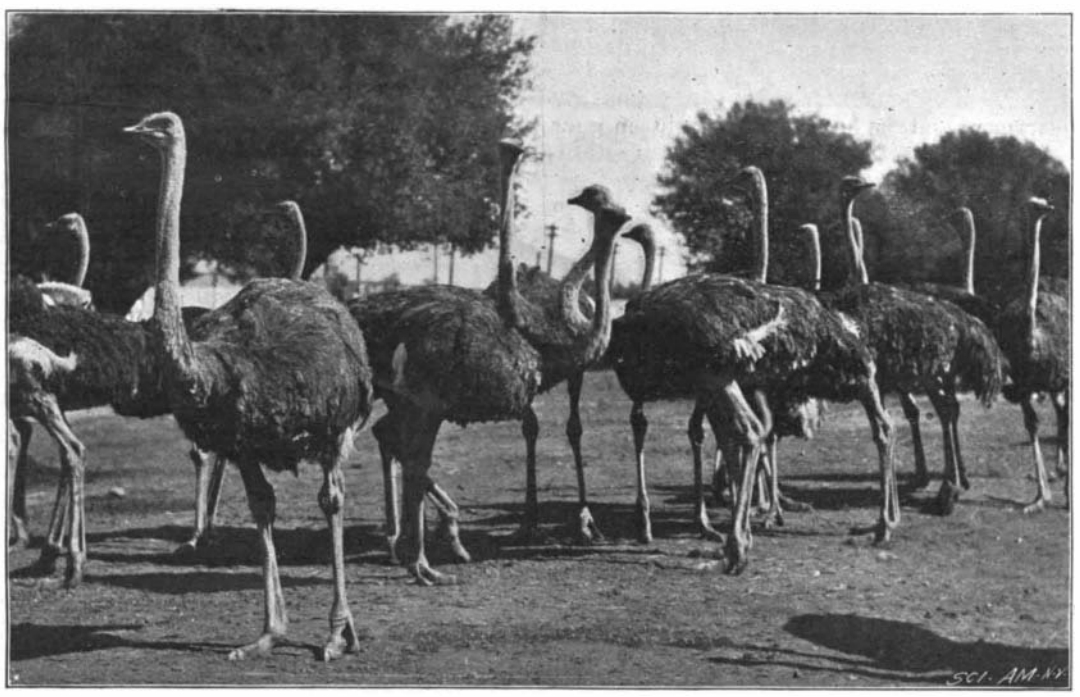
The commercial side of the industry is not without interest. Birds are sold to circuses and shows; the unfertile eggs bring a dollar apiece as curiosities; the feathers are made into boas, which range from $3 to $35; capes, ranging from $16 to $25; fans, tips, single plumes, collarettes, and other objects, suggestive that ostrich farming must be a profitable business; indeed, in South Africa it was at one time ranked next to that of the diamond in point of value.

But the interest in the farm to the average visitor consists in the birds and their strange habits; whether bathing in the pool, or walking jauntily around the corral, or sailing along with outspread wings, they present a fascinating spectacle. The strength of the male ostrich has been the subject of many experiments at the Pasadena farm, and not the least interesting is the great bird used as a saddle horse; a boy mounting the steed and riding it about, the bird carrying its load with the greatest ease. The birds have also been harnessed and driven tandem, to the delight of the young people.

A visit to this farm corrects many errors that may have found place in the mind of the observer. The ostrich does not thrust its head in the sand to avoid its enemy, but boldly charges horse or man, though, sad to relate, a dog will demoralize the entire herd. This is because the ostrich knows that it cannot strike so small an animal. That the birds allow the sun to hatch their eggs is another fiction exploded by a visit to the ostrich farm. No hen displays greater solicitude than does this gigantic mother, who is constantly robbed of her chicks, never enjoys the pleasures of maternity, of leading her young about, but is kept nestling the year around. If allowed to care for her young, the mother ostrich proves to be a famous care-taker. She exercises them all day long, forcing them to run and eat, and at night gives them shelter beneath her warm plumes — the giant mother of the bird creation.



JUST OUT OF THE EGG.



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A CALIFORNIA OSTRICH FARM.

The Current Supplement.

The current SUPPLEMENT, No. 1222, is a most interesting paper, filled with important articles. "A Powerful English Express Locomotive" forms the front page article. Dr. Merrick Whitcomb's article, "Student Life at the Close of the Middle Ages," is one in the University of Pennsylvania Lecture Course and is most interesting. "The Progress of Submarine Navigation" is accompanied by 27 sectional views, showing the principal types of submarine boats of the world. This is a very valuable paper on the subject. "Samoa's Latest Troubles" is accompanied by 10 illustrations giving an excellent idea of the country and its inhabitants. "Crime and the Weather" is an original and important treatise by Edwin Grant Dexter. "The Cork Tree—Its History and Use" is by Nicolas Pike. "Ætheric Telegraphy" is a paper by Prof. W. H. Preece. "Liquid Air an Explosive" is an article by F. H. McGahie; this is an important paper by an expert in explosives.

Contents.

(Illustrated articles are marked with an asterisk.)