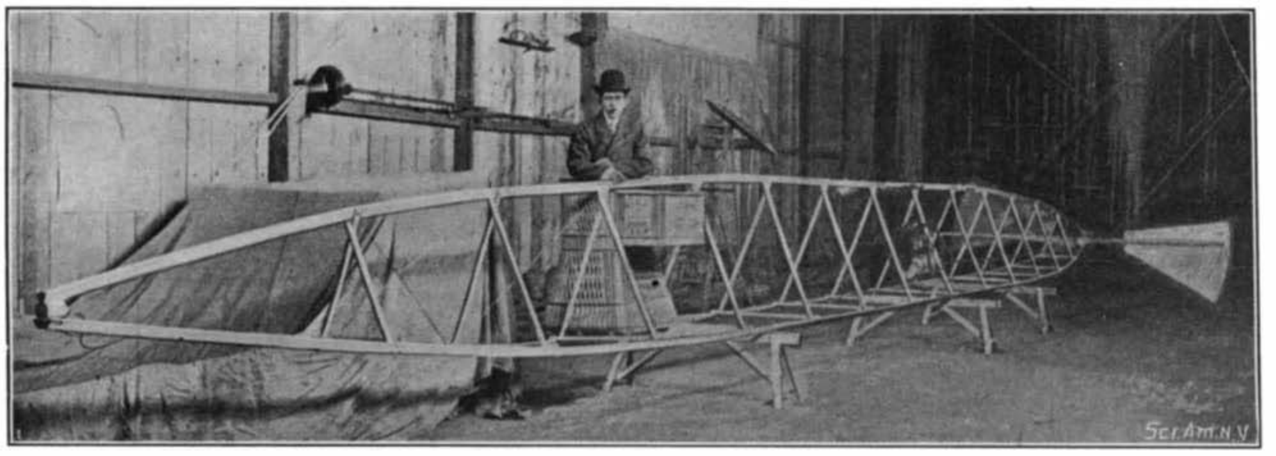
of finance, which, after all, has the last word on the question as to whether an invention shall become a great commercial success.

Messrs. C. A. Parsons commenced the manufacture of steam turbines some sixteen years ago, and in the interim they have applied them with the greatest success as a steam-drive for electrical generators. At the present time the turbines installed in electrical work represent an aggregate of between 140,000 and 150,000 horse power.

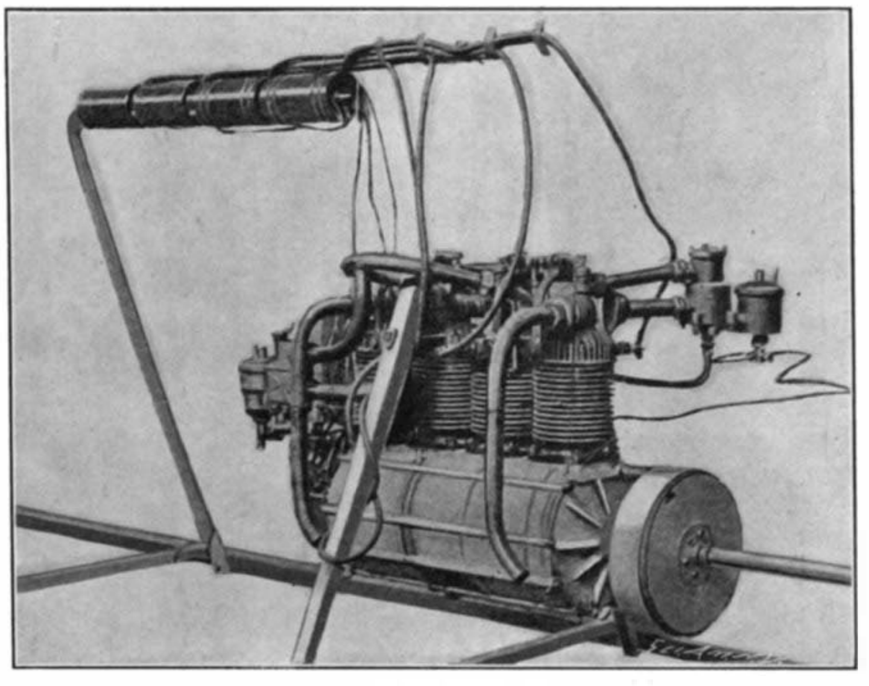


THE FRAME OF THE "SANTOS-DUMONT," SHOWING THE HELIX AND THE BASKET CAR.

The successes achieved by the steam turbine ashore have been repeated afloat, the fastest steam-driven vessels in the world being propelled by Parsons' turbines. In 1897, the "Turbinia," a 40-ton yacht, made a speed on her trial trip of 34½ knots an hour, and later the "Viper," a 370-ton torpedo boat, maintained a mean speed of 36.58 knots an hour during a one-hour trial under English Admiralty conditions of weights and measurement. During these trials the "Viper" showed a coal consumption, per indicated horse power, which was within the guarantees of the contract. The economical operation shown by some of the larger turbines is truly extraordinary, and altogether surpasses the best results achieved by reciprocating engines. The largest size turbines yet constructed are two of 1,000 kilowatts output, built for the municipality of Elberfeld, Germany. During a test by Profs. Schroter and Weber, at an overload of 1,200 kilowatts, a full steam pressure of 130 pounds at the engine, and 10 deg. C. of superheat, the engine driving its own air pumps, the consumption of steam was ascertained to be at the rate of 18.8 pounds per kilowatt-hour. Comparing this result with the best results obtained with reciprocating engines, and taking the highest record of ratio of electrical output to the power indicated at the steam engine, namely 85 per cent, the figure of 18.8 pounds per kilowatt in the turbine plant is equivalent to a consumption of 11.9 pounds per indicated horse power per hour. Although such high efficiency is not to be expected in a marine plant, there is no doubt that the turbines of the "King Edward" will show a great advantage over marine engines of the same power.

As we have recently illustrated and described the "King Edward," we will merely reiterate her general features. She is 250 feet long, 30 feet wide, and her molded depth is 10 feet 6 inches to the main deck. The propelling machinery, of which we present photographic illustrations (the photographs being taken while the motors were in the erecting shop), consists of three steam turbines working compound. They are placed in the ship side by side, and each operates a separate shaft. The center is the high-pressure, and the two on the outside are the low-pressure turbines. Steam is admitted first to the high-pressure, where it is expanded five-fold. Then it enters the two low-pressure turbines, where it expands twenty-five-fold, the exhaust passing directly to the condensers. The total ratio of expansion, it will be seen, is 125-fold. In addition to the low-pressure turbines on the two outer or wing shafts, there are additional turbines, placed inside the exhaust ends of the low-pressure turbines, which are used in going astern. There are in all five propellers—one upon the center high-pressure turbine shaft, and two upon each of the outer low-pressure shafts, the outer shafts being used in going astern. The feed pumps are driven by separate engines, as are also the forced draft fan and the circulating pumps for the condenser. The main air pumps are worked by means of worm-gearing from the wing, or outer, shafts, the details of one of these pumps being shown very clearly in our illustration. In addition, there are auxiliary air pumps which are driven by the circulating pump engines. These are used for emptying the condensers of water when they are not in operation. The boilers are double-ended, of the return-tube type, with four furnaces at each end.

The motors, the condensers full of water, the steam pipes, the auxiliaries, the shaft, propellers, etc., weigh altogether 66 tons; and as the indicated horse power on the trial trip is estimated to have been 3,500, it will be seen that the engines compare favorably with

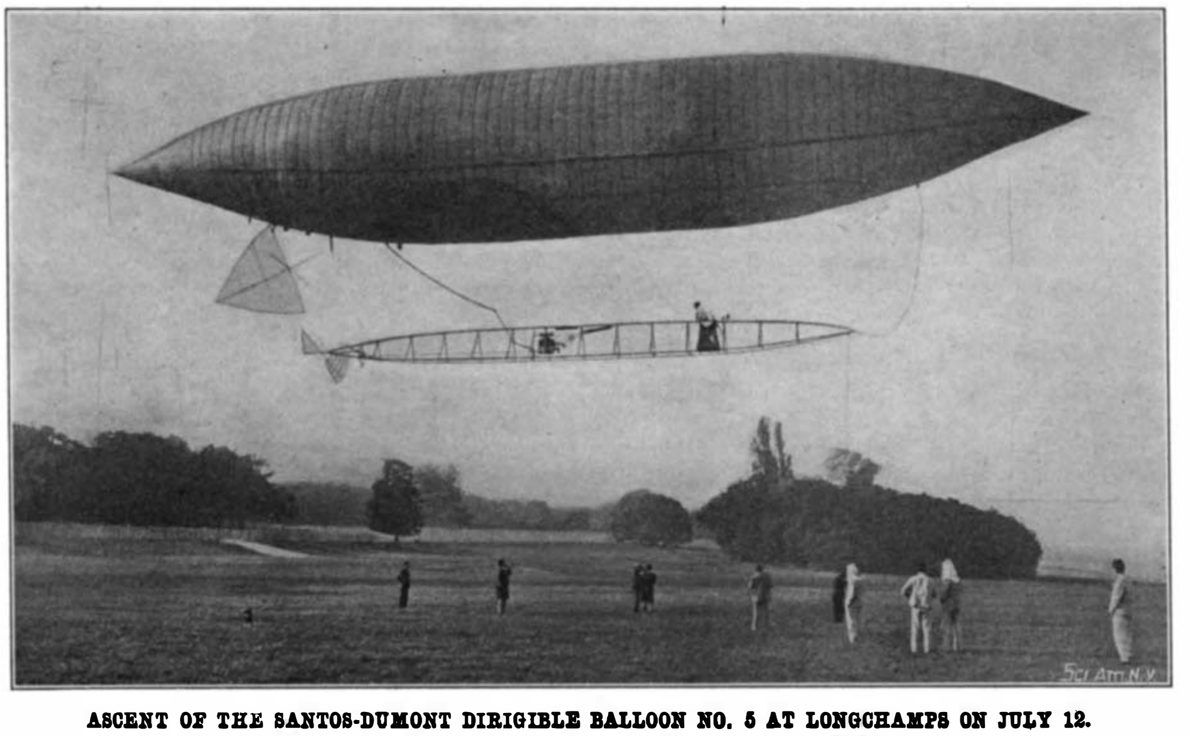


THE 16 HORSE POWER FOUR-CYLINDER SANTOS-DUMONT MOTOR.

engines of the standard reciprocating type. They are exceedingly light for the power they develop, the weight per indicated horse power being only about half that which is common to the engines of the paddle boats which are ordinarily used in the service for which the "King Edward" has been designed. On the trial of the "King Edward" on the Firth of Clyde, a speed of 20.5 knots an hour was registered as the mean of several runs over a measured mile. The mean revolutions were 740 per minute, the boiler pressure 150 pounds to the square inch, and vacuum 26½ inches, the pressure in the stokehole being equal to one inch of water. The new vessel is considerably faster than any of the river steamers of her class engaged in the same work, her speed exceeding that of her competitors by about one and a half knots per hour.

THE SANTOS-DUMONT BALLOON.

The balloon of M. Santos-Dumont, which made a successful trip across Paris, as recorded in the SCIENTIFIC AMERICAN for July 27, is the fifth which he has built, and we are now enabled to give some detailed views of this remarkable airship. The balloon proper is cylindrical and is covered with silk, its extremities being pointed. It is 111 feet long, and its cubical capacity is 19,300 feet. Suspended by piano wire some 35 or 40 feet below the balloon is a light framework whose profile very much resembles that of the balloon proper. The framework is triangular in section, and is formed of three long pieces of wood, secured at the end and strengthened by cross-bracing and steel wires. This framework supports a four-cylinder, sixteen horse power motor of the Dion-Bouton type, the fuel reservoir, the shaft and the propeller. The engine is placed well toward one end, and the aeronaut rides in a light basket at the other end. Here he has under his control all of the machinery for maneuvering the balloon, also the ballast and the guide-ropes. The respective positions of the various weights were determined after many experiments, and its equilibrium is perfect. This assures its horizontality and an equal tension on the suspenders. This explains why the aeronaut is so far separated from his motor. The propeller, 14 feet in diameter, is composed of two vanes of wood and steel, covered with silk and highly varnished; it attains a speed of 150 turns a minute. The steering device is of silk and is placed between the balloon and the framework above the propeller. The balloon is inflated with hydrogen, and in order to maintain at all times a tension on the envelope—that is to say, perfect inflation—a compensating balloon filled with air is placed in the interior. This is inflated automatically, as required, by a small compressor actuated by the motor, the air being conducted to it by tubing. A guide-rope is suspended under the framework, and with its aid the necessary inclination is obtained to effect the movements of ascent and descent. Such, in brief, is the apparatus and method employed by M. Santos-Dumont. After his slight mishap on the day of his remarkable trip on the 13th of July, M. Santos-Dumont repaired the damage, and on July 29 he made another ascent. He had arranged to make his promised trip over Paris in the afternoon, but was obliged to abandon the idea, as he found that the motor was working badly. In order, however, not to disappoint the numerous visitors to St. Cloud, he gave a maneuvering exhibition over the Bois de Boulogne. Several ascents were made, and the guide-rope frequently caught in the trees, but it was released without any harm being done. The visitors were all astonished at the marvelous control the inventor had over the balloon. The motor is still giving him trouble, and on his last trip the screw was frequently at a standstill. The balloon's great size and the absence of landing platforms help to make the ascents and descents diffi-



ASCENT OF THE SANTOS-DUMONT DIRIGIBLE BALLOON NO. 5 AT LONGCHAMPS ON JULY 12.

cult. For our engravings we are indebted to L'Illustration.

Osmium Filament and Lamp.

M. Auer von Welsbach has found a method of making incandescent lamp filaments of osmium, and the new lamp presents decided advantages. The incandescent lamp is more economical the higher the temperature at which the filament burns, and as osmium is the metal which has the highest fusing point, it is found that it can be burned at a higher temperature than the carbon filament, with consequent economy of energy. Although osmium has usually been recognized as a pulverulent or spongy body, or again in its hard form, the inventor has succeeded in making filaments of it, and the new lamp is receiving considerable attention. It not only gives more light for a given consumption of energy, but its life is said to be greater than that of the carbon filament; the osmium lamp takes 1.5 watts per candle power and lasts 600 hours, even reaching as high as 1,000 to 1,200 hours. When the bulb has become darkened on account of the deposit, it may be cleaned easily and cheaply without having to change the filament or bulb. On account of the lower electrical resistance of the osmium filament the lamps are burned at a lower voltage than for carbon filaments; they are made at present for tensions of 20 to 50 volts. On an alternating current system this voltage is easily obtained by the use of the proper transformers. Another advantage of this low voltage is found in its use with accumulators, as a less number of cells are required; on account of the diminished weight the system promises to be valuable for vehicle and railroad lighting. According to the experiments carried out by M. Scholz, the lamp has an economy of 60 per cent over the present lamp. It is said that the lamp is already being made in capacities from 5 to 200 candle power.

An accident recently occurred in the power station of the Edison Electric Illuminating Company, Duane Street, New York city. The comments of the daily papers upon the accident are amusing. The following are some examples: "Like a sharp clap of thunder and with a flash of blue flame the huge 12-foot rotary high-tension converter of the Edison Electric Illuminating Company, making thousands of revolutions a minute, exploded early last night, scattering tons of iron and copper all over the place." Another paper said: "Electric flames poured through the gate on Duane Street and shot up the front of the building." Still another said: "The wheel, weighing more than five tons and 12 feet in diameter, went to pieces without a second's warning, splitting into thousands of fragments." The following is equally interesting: "Fifty men fled for their lives when the rotary of one of the high-tension converters burst."

The Building Edition for August.

The SCIENTIFIC AMERICAN Building Edition for August is an extremely beautiful number of this interesting and elaborately illustrated periodical. The residence of Claus Spreckels, at San Francisco, and the house of the Hon. William C. Whitney, in New York, are both illustrated and described. Several interiors of the Spanish-American missions are also shown. The houses selected for this issue are charming, and there are a number of views of interiors. The editorial is entitled "The House and the Home." The monthly comment contains many remarks pertinent to houses. The talk with architects this month is given by Mr. Walter Cook on "The Large City House." The column of "Household Notes" is a new and interesting feature. Those who have not seen the Building Edition in the last few months should purchase a copy of the August number.

The Current Supplement.

The current SUPPLEMENT, No. 1336, is opened by a large engraving showing M. Santos-Dumont navigating his balloon. "Household Tests for the Detection of Oleomargarine and Renovated Butter" is by G. E. Patrick, Department of Agriculture. "Marketing and Preserving Eggs" is a most elaborate treatment of the subject. "The German Colony of Togo" is accompanied by eight illustrations. "Some Advances Made in Astronomical Science During the Nineteenth Century" is by C. L. Doolittle. "The Series Alternating System" describes some interesting transformers.

A New Kind of Gas Tubing.

A new kind of gas tubing is put on the market, which is recommended for use where there is any risk of the rubber being burnt, as in gas cooking stoves, ironing, chemical works, etc. The rubber tubing is covered with finely woven braid of asbestos, and further with incombustible paint, which will withstand a great amount of heat. Numerous accidents occur through the tubing coming in contact with the gas flame, or with heated materials, and this new article, showing decided advantages over ordinary rubber tubing, should command a ready sale.

A NEW FORM OF BAROMETER.

BY EDWARD COLEBIDGE ROBERTS.

When barometers are constructed for absolute measurements it is necessary that the vacuum be as good as may be, perfect if possible, in order that wide differences of temperature may not alter the readings except through the expansion of the mercury, and that its reading may correspond with that of other standard barometers. Where the barometer is used merely as a weather glass, however, different conditions obtain. Here, as the instrument will probably be kept indoors, the temperature will vary but little between two readings, or even through the year. The total variation is not more than 20 degrees F. indoors, and not more than 10 degrees F. from day to day. Therefore no serious error will be introduced in the position of the mercury column under different air pressures, even if the tube be not boiled out.

When any one undertakes to build for himself a barometer, and is, as many of us are, more blessed with manipulative skill than with this world's goods, the following form possesses points of interest.

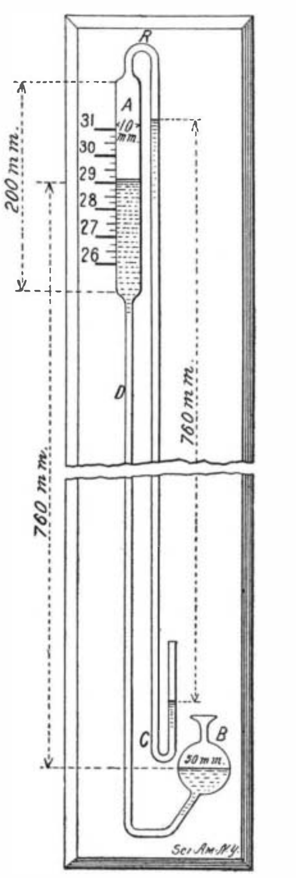
In building a barometer such a person will pay attention to the following points:

1. The necessary amount of mercury should be as small as possible.

2. Both mercury surfaces should be large, the upper being not less than 1 centimeter in diameter, and the lower about 4 or 5 centimeters.

3. The construction should permit of easy filling, to facilitate transportation.

These conditions are all met in the form of instrument shown in the drawing. The tube, *A*, 1 by 20 centimeters, is sealed at both ends to a thermometer tube whose internal diameter is about 1 millimeter. This tube is then bent as shown, and to the end of the length, *D*, is sealed the bulb, *B*, whose diameter is about 5 centimeters. In bending the tube care must be taken that the dimensions given on the drawing are carefully adhered to. The whole tube must then be carefully cleaned with nitric acid, and is then washed in succession with distilled water, alcohol, ether, and dry air. It is then attached to a suitable frame, and is ready to be filled with mercury.



The particular form of the tube makes filling a very simple matter. Sufficient mercury is poured into the bulb, *B*, to a little more than half fill it. The whole thing is then laid on edge with the bulb, *B*, up. The mercury will then flow around through the whole tube, driving the air out before it through the tube, *C*. When the whole is filled, the barometer is quickly turned up on end again. Now the distance from *R* to the surface of the mercury at either *B* or *C* is more than 30 inches, and consequently the column breaks at *R* and settles down till on each side it is 30 inches high. Here we have practically two barometers in parallel, the one, *C*, acting in this case merely as an airtight seal to the top of the tube of the other. The advantages of the construction are these:

1. The effective diameter of the tube is the same as that of the part, *A*, while the amount of mercury contained in the apparatus is reduced by about one-half.

2. The impossibility of filling a tube like this were it sealed off at *R* is obviated by the addition of the part, *C*, which permits of the easy expulsion of the air, and then forms a seal to prevent its re-entrance.

A barometer has been constructed on these lines, and has been in use for the last six months. The closeness of its readings to those of a Bortin barometer show that little, if any, air is present in the tube.

Its construction occupied about a day and a half, most of which was spent on the glass blowing, as the writer was not extremely proficient at that art. The work could be repeated in a much shorter time. If this short description shall be of encouragement to any would-be observer of the barometer, I shall feel that the time spent in the construction of the instrument has by no means been wasted.

Ithaca, N. Y.

The construction of cement houses is under consideration at Pittsburg. Vast quantities of furnace slag are produced each year which might thus be utilized.

THE NEW BATTLESHIP DESIGN CONTROVERSY.

When Lieut. Strauss several years ago drew up his design for the double-decked turret, it is probable that he little imagined that he was opening the way for a storm of controversy, the like of which, surely, has never been seen in the bureaus of our navy. From the very first the new device met with vigorous opposition, some of which was due to the distrust which a radical innovation inevitably arouses, while most of it was due to considerations of a more or less technical character. On the other hand, the military and tactical advantages of the double turret were so obvious that it was bound to secure a large following, particularly among the line officers, to whom the great concentration of fire secured by the system was naturally very attractive.

The subject was well threshed out when the designs of the "Kentucky" and "Kearsarge" were under consideration. It was again up for earnest and lengthy discussion when the designs of the "California" and "Virginia" type were being drawn up, and it now dominates the discussion of the Naval Board of Construction, who are engaged in planning the new battleships authorized by our last Congress. Two radically different types of ship, or, to be more correct, two types with radically different batteries, are proposed, one drawn up by Rear-Admirals Bowles, O'Neil and Melville, and the other embodying the latest ideas of the advocates of the double turret, as presented and strongly advocated by Rear-Admiral Bradford and Captain Sigsbee.

We present a sheer plan and deck plan of each design, together with a diagram showing the maximum concentration of fire possible from the intermediate and secondary batteries of each vessel. The 12-inch guns are not included, for the reason that they are common to both designs. The type of battleship approved by Admirals Bowles, Melville and O'Neil has the following general dimensions: Length, 450 feet; beam, 76 feet; mean draft, 24 feet 6 inches; displacement, 15,560 tons. The total displacement, with everything on board and full bunkers, will be 16,900 tons, and the draft at the greatest displacement will be 26 feet 4 inches. The vessel is to have a speed of 19 knots, with an indicated horse power of 20,000. The battery will consist of four 12-inch guns in two turrets protected by 10-inch armor, twenty 7-inch rapid-fire guns protected by 7-inch armor, and twenty 3-inch rapid-firers behind 2-inch armor. The 12-inch guns will be carried in pairs in fore and aft turrets on the main deck. On the same deck four 7-inch guns will be mounted at the four corners of a main deck battery. They will be completely inclosed by a semicircular wall of 2½-inch armor, which will connect with an outside wall of 7-inch armor, forming an inclosed casemate. On the gun deck below there will be sixteen 7-inch guns carried in broadside. These will be protected in front by a complete wall of 7-inch armor. The four guns at the corners of the battery will be entirely inclosed by a wall of 2½-inch armor at the rear, the protection being similar to that of the four 7-inch guns on the deck above. The twelve other 7-inch guns on the gun deck will be protected from the effects of shells bursting between decks by transverse walls of 2½-inch armor, which will extend across the gun deck between each pair of guns, there being thus two guns between each inclosed section. The twenty 3-inch guns will be disposed as follows: Fourteen on the main deck, protected by 2-inch armor, and six similarly protected on the gun deck. Of the 3-inch battery on the main deck, two guns will be carried at each corner of the central battery, and six will be carried, three on each broadside, between the 7-inch guns of this battery. Of the six 3-inch guns on the gun deck, two will be carried forward, one on each beam, and four astern. The concentration of fire ahead will be two 12-inch, four 7-inch and six 3-inch, while astern it will be possible to concentrate two 12-inch, four 7-inch and eight 3-inch guns. On either broadside the concentration will be four 12-inch, ten 7-inch and ten 3-inch.

It will be seen that in this design the 8-inch gun and double turret are entirely eliminated. The 7-inch gun is adopted in place of the 8-inch for the reason that the former exceeds the latter in range, flatness of trajectory and rapidity of fire. It will also weigh considerably less per total energy of fire delivered in a certain time. The double turret is thrown out on both tactical and structural grounds. Tactically, it is considered to be subject to the grave disadvantage that one man is responsible for the training of all four guns and that independent aiming is therefore impossible. Admiral Bowles uses the homely, but very apt, simile of one sportsman armed with a four-barreled shotgun and four men each armed with a single-barreled shotgun, and suggests the obvious inference that four men would be likely to make a better bag than the single sportsman. The majority of the Board also consider that the superposed turret has the objection that a single, well-placed shot from a heavy gun might throw two 12-inch and four 8-inch guns, or one-third of the main battery, out of action.