### ATTACK ON THE COAST-DEFENSE SHIP "BELLEISLE."

It is a curious fact, that although Great Britain possesses such an enormous navy, greater, indeed, than that of the two next largest naval powers, she has never had an opportunity to submit her theories of attack and defense, as embodied in her modern fleet, to the practical test of war. It has been the lot of the two youngest in the modern navies of the world to gather in the priceless experience which is to be reaped from a naval campaign. Japan at the battle of the Yalu, and the United States at Santiago and Manila, gained more practical experience than could be gathered in a whole decade of proving-ground experiments.

In the recent costly trial with the "Belleisle," the British Admiralty endeavored to reproduce as far as was practical, the conditions of an actual sea fight, selecting in this vessel one of the many obsolete battleships, which appear in the lists of the British navy under the head of "Coast Defense Ships." The "Belleisle," which was completed in 1878, is an iron vessel of 4,870 tons displacement, with engines of 2,600 horse power, giving a trial speed of 11·9 knots. She is protected by a continuous belt of armor, which varies from 12 to 6 inches in thickness. Amidships is an octagonal redoubt and battery, which is protected by armor varying in thickness from 9 inches to 5 inches, and carried within this redoubt, at the four angles, are four 12½-inch muzzle-loading guns; above the battery are six 6-pounders, a few smaller rapid-fire machine-guns being scattered throughout the vessel. The "Belleisle" was moored off Selsey Bill, not far from the Portsmouth dockyard, and above what is known as the Medmerry Shoals, shoal water being selected to insure that in case the vessel foundered, she would sink but a few feet before touching bottom. To give the test its full value, and reproduce actual fighting conditions, the ship was cleared for action. Splinter nets were spread, torpedo nets were run out, and the ship's boats were left upon the davits. To determine the effect of gun-fire upon the crew, dummy sailors were placed about the guns in positions corresponding to those which would be occupied in an engagement. The fire-fighting hose was run out and the pumps were started, the decks being kept continuously wet during the bombardment.

The first-class battleship "Majestic" was selected to make the attack. This is one of the most formidable vessels of the British navy, with a displacement of about 15,000 tons, and an armament of four 12-inch breech-loading rifles, twelve 6-inch rapid-fire guns, eighteen 3-inch rapid-fire guns, and twelve 3-pounders. The "Majestic" approached the "Belleisle" from astern, and at a distance of 1,700 yards turned to port and opened fire. She steamed on an elliptical course around the port side of the vessel, the range varying from 1,700 yards astern, to 1,300 yards abeam and 1,700 yards ahead. The speed of the "Majestic" was 12 knots an hour. The attack was made with the whole available battery and lasted just 9¼ minutes. It is estimated that during this time the "Majestic" fired eight rounds of 12-inch common shell, about the same number of 12-inch armor-piercing shell, two hundred rounds of 6-inch shell, half of them being loaded with lyddite, and half of them being common shell; also between four hundred and five hundred projectiles were fired from the 3-inch guns and between seven hundred and eight hundred from the 3-pounders. The result is shown in

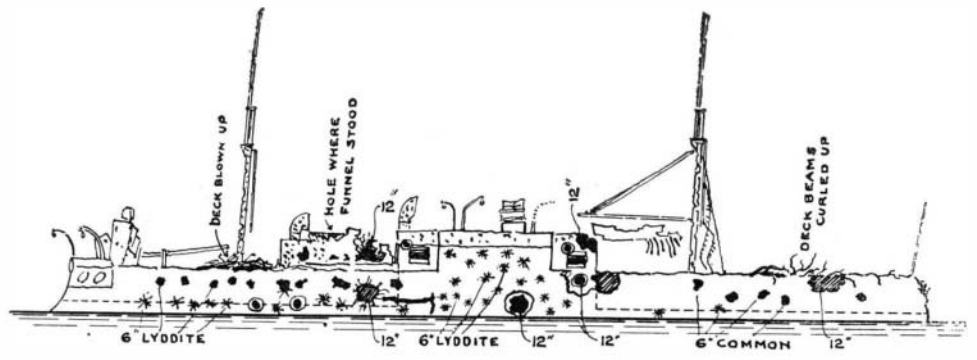
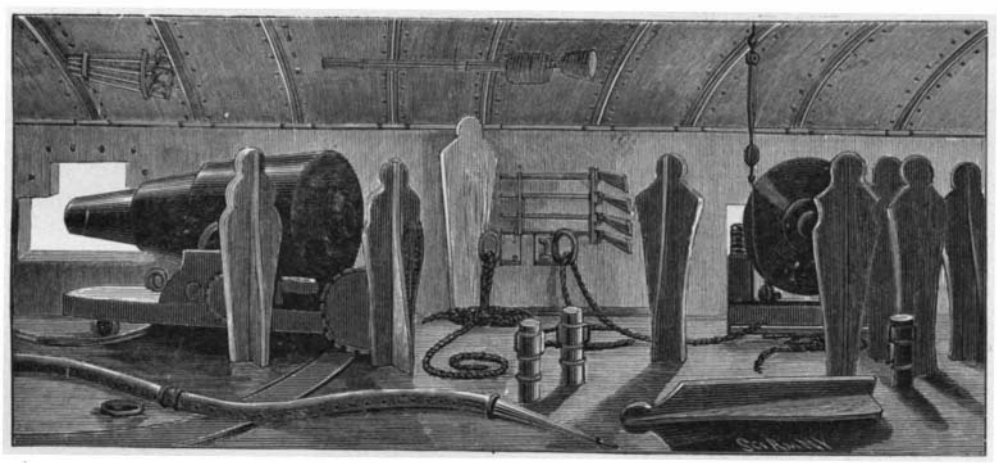
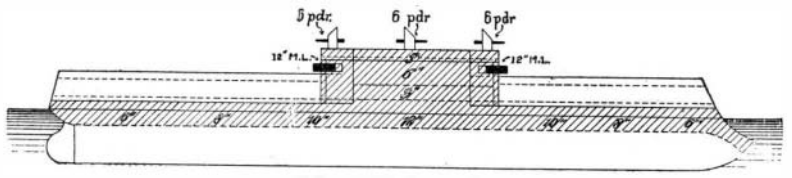


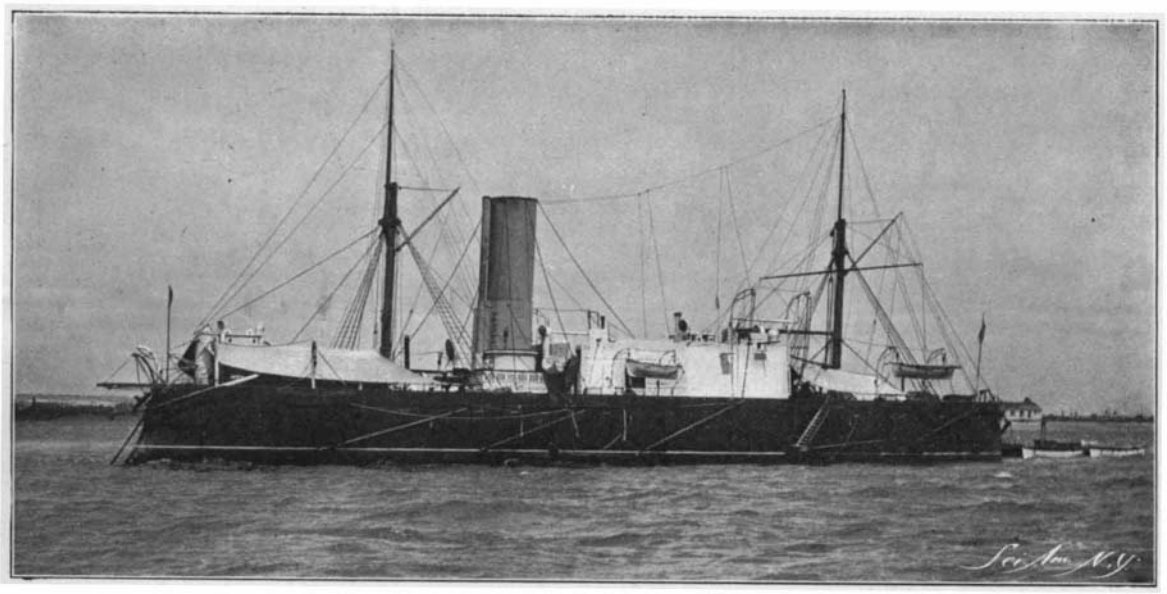

DIAGRAM SHOWING HITS WITH 6 AND 12-INCH SHELL.



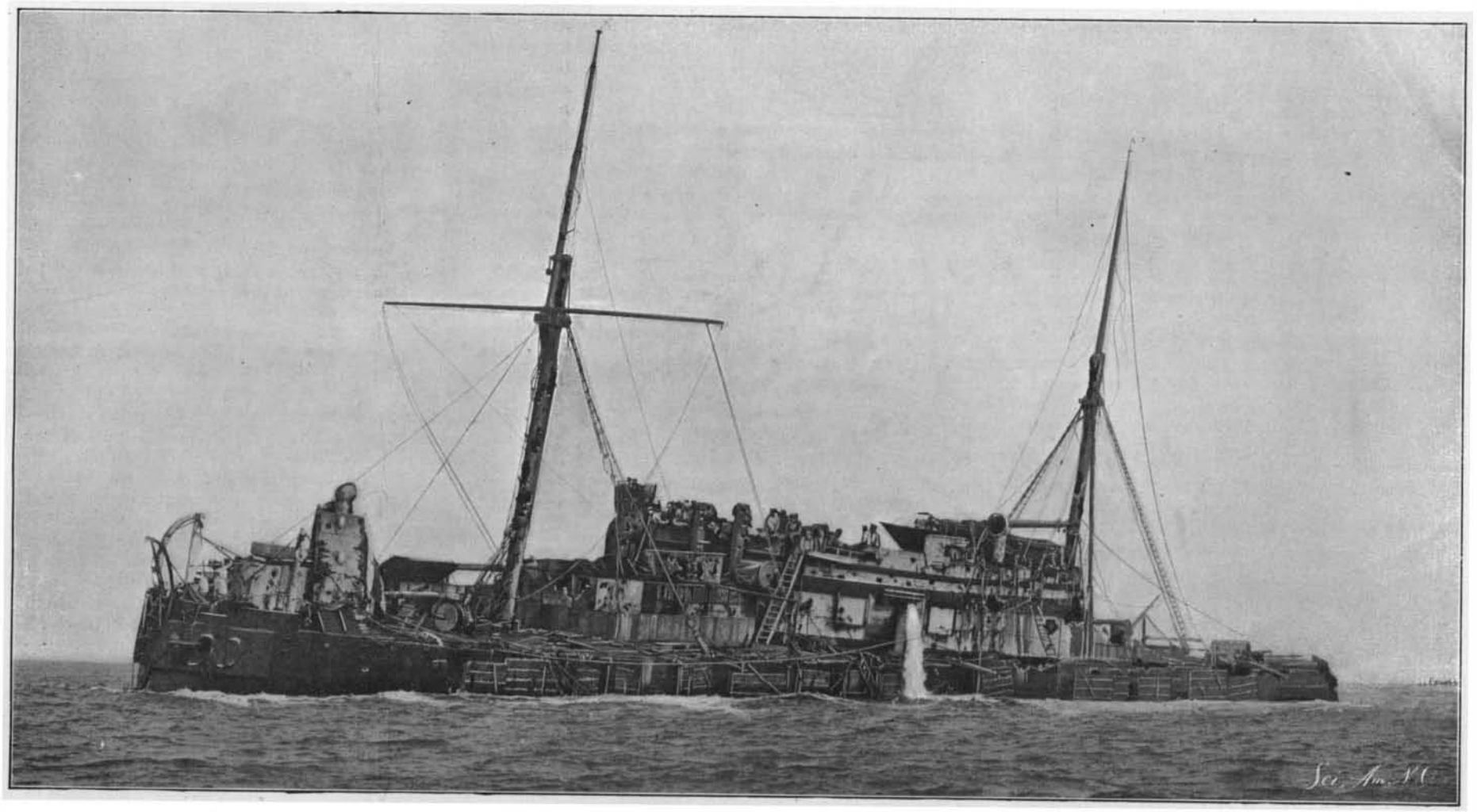
INTERIOR OF BATTERY, SHOWING 12½-INCH MUZZLE-LOADING GUNS AND DUMMY CREW.




ARMOR DIAGRAM.



COAST DEFENSE SHIP "BELLEISLE," SELECTED FOR THE EXPERIMENT.



CONDITION OF "BELLEISLE" AFTER 9¼ MINUTES' ATTACK BY FIRST-CLASS BATTLESHIP "MAGNIFICENT."

the accompanying photograph by Symonds & Company, of Portsmouth, which was taken after the shot-holes had been plugged and mattresses placed over the huge rents which had been blown through the vessel's sides—precautions which were necessary to prevent her from foundering on the trip to Portsmouth.

Among the voluminous data, of more or less technical accuracy and value, published concerning this remarkable experiment, by far the best is that which appeared in The Engineer, London, to which we are indebted for the accompanying diagram of hits recorded after the bombardment. As was to be expected, the greatest destruction was wrought by the 12-inch guns. Commencing at the bow and comparing the views of the ship taken before and after attack, it will be noticed that the deck structure at the bow, erected for the accommodation of seamen, has been blown away and thrown over on end, presumably by a 12-inch shell. In the after part of the funnel-casing there is a huge gap apparently made by a 12-inch shell, and as the funnel has entirely disappeared it is probable that it was blown away by the same projectile. Below this hit, at the upper edge of the belt, is a large indentation probably caused by a 12-inch common shell which, though it did not go through, opened a long, lateral crack about 6-inches in width in the armor. The most serious 12-inch hit, and the one that ultimately sunk the vessel, struck directly beneath the battery at the top of the belt, passed entirely through the armor, and blew a considerable portion of the side entirely inwards, one fragment of the armor being driven up through the flat armored deck, which, at this point, is 3 inches in thickness. The side armor here is 12-inches thick and is backed up with 16 inches of oak. Strange to relate, no damaging fragments seem to have passed into the engine room. It should be mentioned that this shot struck very obliquely.

Another 12-inch shot struck the after angle of the redoubt. It burst and blew out a hole about 12 feet square on the side and deck of the vessel, the head of the shell making a penetration in the armored face of the redoubt. Above this shot-hole is a clear penetration through the 6-inch armor of the battery, while adjoining it a 12-inch shell has broken out a fragment of the armor. Well aft on the quarter deck a 12-inch common shell has blown in a considerable portion of the side of the vessel and torn up a large area of the deck. The deck beams are described by an eye-witness as being curled up like a lot of shavings, the cabins in the locality of this hit being reduced to matchwood.

In the earlier moments of the bombardment the 6-inch rapid-fire guns attacked the after portions of the vessel with common shell, scoring the hits shown in the accompanying diagram. As the "Majestic" drew abreast of the "Belleisle," 6-inch lyddite was substituted for 6-inch common shell, the attack being directed at the midship battery, the redoubt and the bow. It seems that the destruction by the lyddite was enormously greater than that by common shell. Both, penetrated the unarmored ends, but neither was able to do any damage to the armor plate. When lyddite shells passed through the unarmored end they reduced the interior woodwork to splinters; but with this difference, that while the common shell split up the woodwork, the lyddite is described as having pulverized it completely, nothing remaining of it but dust. Where the 6-inch common shell burst between decks, the deck above shows but little signs of the explosion, but where lyddite burst, not only are there huge holes blown up through the deck, but the entire deck in the neighborhood of the explosion has been lifted. Although the deck beams were plentiful, their resisting power against lyddite seems to have been practically nothing. In the diagram of hits, the penetrations are marked in full black, and the bursts of the 6-inch lyddite and common shells against the armor are marked by stars.

Summarizing the minor damages, it may be said that the masts are almost cut in two, and the ship's boats are so completely torn to pieces as to make it certain that no ship's boats will be available after a severe action. The bridge is much bent and twisted, and the bridge searchlight blown away; although the conning-tower escaped injury. The upper works were blown to pieces, the 6-pounders being either carried away or blown over sidewise, some of their fittings curiously enough being melted. Although the big guns inside the main battery were unhurt, the gun sights were destroyed; while the dummies which stood around were all burned.

When the boarding party reached the ship they found that water was still being pumped through the hose and that the decks were flooded. Contrary to expectation, no fire had broken out on the vessel. Too much importance, however, must not be attached to this fact, for the ship being stationary, there was no draft of air to assist a fire, as there was in the case of the Spanish cruisers that were destroyed at Santiago. The lessons of this valuable experiment are discussed in our editorial columns.

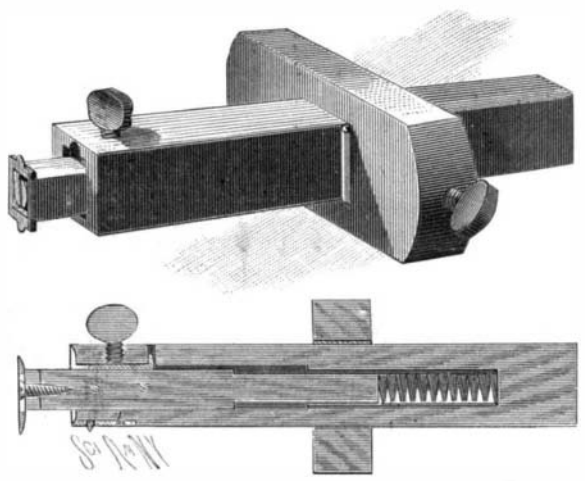
### Tips for Inventors.

The Keystone, devoted to the interest of jewelers and opticians, published monthly in Philadelphia, suggests that the inventors of the future will be those who carefully study the natural world. The stones of the mills are another style of the molar teeth. The hoofs of horses are made of parallel plates, like carriage springs. The jaws of the tortoise and turtle are natural scissors. The squirrel carries chisels in his mouth, and the hippopotamus is provided with adzes, which are constantly sharpened as they are worn. The carpenter's plane is found in the jaws of the bee. The woodpecker has a powerful little trip-hammer. The diving-bell imitates the water-spider, which constructs a small cell under the water, clasps a bubble of air between its legs and dives down into its submarine chamber with the bubble, displacing the water gradually, until its abode with fishes contains a large, airy room surrounded by water. In leaving its eggs on the water the gnat fastens them into the the shape of a lifeboat, which it is impossible to sink without tearing it to pieces. The iron mast of a modern ship is strengthened by deep ribs running along its interior; a porcupine's quill is strengthened by similar ribs. The frame work of a ship resembles the skeleton of a herring. When engineers found that hollow pillars were stronger than solid ones, they only discovered a principle that is very commonly seen in nature. A wheat straw, if solid, could not support its head of grain.

### AN IMPROVED MARKING-GAGE.

Our illustrations present a novel marking-gage, provided with means for automatically adjusting one marking-point relatively to the other, thereby saving time in making adjustments. The inventor of the gage is Julius Opland, Calumet, Mich.

The device comprises a hollow stock upon which the usual head-block is adjustably carried. Within the stock is a spring-pressed adjustable point-carrier, held in any desired position by means of a set-screw passing



A GAGE WITH ADJUSTABLE MARKING POINT.

through the stock and engaging a bearing-plate provided with an upwardly-extending lug, which enters an opening in the stock to prevent outward movement. To the under side of the stock, a plate carrying a marking-point is secured; and screwed to the outer end of the spring-pressed carrier is another plate provided with two marking-points, so that when one is worn away, the other can be used.

In making a double line with this gage for marking out a mortise, or the like, the set-carrier is released so that it can be moved outwardly by its spring. By holding the stock in one hand and a finger of the other hand against double-point plate, the carrier can be readily stopped at the proper measurement on the rule and locked in place by the set-screw.

When it is desired to use only the marking-point on the stock, the double-point plate on the end of the carrier is moved up and its lower point seated in a notch in the stock. By this arrangement the outer surface of the plate will be flush with the end of the stock.

### Electro-Chemical Congress at Paris.

The Fourth International Congress of Applied Chemistry, which will be held at Paris from the 23d to the 28th of July, will include ten sections, of which the tenth, devoted to electro-chemistry, promises to be of especial interest. M. Henri Moissan is president of the committee, which also includes other well-known scientists. The provisory programme for the electro-chemical section includes the following subjects: Batteries, dynamos, accumulators; galvanoplastic processes and material; production and use of ozone; production of chlorine and of soda, chlorates of potassium and sodium, etc.; electrolytic production of metals, copper, nickel, chromium, etc.; aluminium and its alloys, magnesium, sodium and its alloys; organic compounds. The subject of electric furnaces will form an important part of the programme, and the production of phosphorus, manganese, tungsten, etc., will be considered, as well as that of metallic carbides and carborundum. Among other subjects are the preparation of carbide of calcium, industrial furnaces and their efficiency, fabrication of acetylene, conditions of use, and purification, also generators and burners. Electric bleaching, disinfection, and other subjects will complete the programme.

### Automobile News.

Charging stations for electric automobiles have been established at several points between Oxford and London.

The Prince of Oldenburg has recently made a remarkable trip in the Caucasus; he traveled in an automobile of the Gardner-Serpollet make, which obtained the prize for the handsomest vehicle at the last exhibition at Monte Carlo. He gives an account of his trip in the following telegram sent to M. Serpollet, dated from Pati, in the Caucasus: "I have just finished with brilliant success on your automobile, in the presence of the Minister of Roads and Bridges, the distance from Novorossik to Sookhoom, more than 312 miles, in the Caucasus Mountains, over an unfinished route, with steep grades and sharp turns, crossing the rivers by fords and rafts. The machine, carriage, and pneumatics were faultless."

An interesting series of races has been held from Nuremberg to Bamberg. The race for motor cycles was won by Herr Hasemann; that for automobile carriages was won by Herr Schmidt, who covered the distance in 2 hours and 9 minutes, with Baron Scarisbrück second; the third competitor, Herr Bender, of Mannheim, had an accident with his tire, and thus lost his position in the race, but deducting the time lost for making repairs, he covered the distance in 1 hour and 38 minutes. Of the touring machines that of Herr Enders, of Nuremberg, won the race, the time being 2 hours 41 minutes and 47⅘ seconds. The race for road wagons had six competitors. It was won by Herr Wegelin, of Augsburg, in 2 hours and 37 minutes.

Inter-communication with the various manufacturing centers of Lancashire, Eng., has always been deficient or expensive. With a view to overcoming the difficulty, the Liverpool Self-Propelled Traffic Association are encouraging the utilization of the automobile wagons for the carriage of goods from one place to another. Next June it is proposed to hold a series of experiments under the auspices of this association for the purpose of ascertaining what types of vehicles are best adapted for road haulage traffic. The competition is to be divided into three classes as follows:

| Class. | Load. | Maximum Tare. | Minimum Level Platform Area. | Minimum Width of Driving Tyres. | Speed. |
|---|---|---|---|---|---|
| | Tons. | Tons. | Sq. Feet. | Inches. | Miles per Hour. |
| A..... | 1½ | 2 | 45 | 3 | 8 |
| B..... | 5 | 3 | 75 | 5 | 5 |
| C..... | 5 (minimum) | No limit. | 95 | 6 | 5 |

A Lancashire syndicate is being formed for the purpose of taking over the type of wagon best suited for road work, and this syndicate proposes to inaugurate a service of road transport between Liverpool and the other principal manufacturing towns of the county.

The automobile industry, though still in its infancy in Germany, is being rapidly developed, and, in the opinion of the United States Consul at Leipzig, is destined to become an important factor in the manufacturing industries of the country. The large amount of capital and energy which is being expended upon this branch of industry indicates that the German business men have great confidence in the future of automobilism. Last year there were about 1,000 men employed in and around Berlin in the automobile industry, and it is expected that this number will be more than doubled during the present year. In France, the results which have been aimed at for the most part have been to obtain excellence in sporting and luxuriantly appointed automobiles, while in Germany just the opposite state of affairs has existed; the manufacturers have given more of their attention to making motor vehicles for the carriage of goods, and not without success, as was shown at the International Motor Wagon Exhibition, which was held in Berlin last year. For motive power, electricity and gasoline are almost exclusively employed; the use of steam power is as yet hardly out of the experimental stage; the same may be said of the employment of compressed and liquefied air, and of combined systems (gasoline and electricity, etc.). Electricity as a motive power has a strong competitor in gasoline; the electric automobile seems to be preferred to the gasoline type on account of its simple mechanism, less noisy running, and the absence of unpleasant odors. The gasoline automobile is used principally in transporting heavy loads, where great speed is desired, in the case of long distances, heavy grades, and where other difficulties are likely to occur. Hence, its adoption in Germany for brewery wagons, drays, omnibus lines connecting railway stations with inland towns, and for carrying passengers and loads in the country.