Marconi system is good enough for the venture into wireless. To that there seems but one answer. Therefore we regret the six months postponement. When they are over, there should be no further delay.

THE TURBINE AT SEA.

A PHENOMENAL DEVELOPMENT.

By Robert Cromie
In *The World's Work.*

The Hon. Charles Algernon Parsons, M.A., D.Sc., F.R.S., etc., proprietor of the electrical and engineering works of C. A. Parsons & Co., at Heaton, Newcastle-on-Tyne, and Managing Director of the Parsons Marine Steam Turbine Co., Ltd., is the fourth son of the third Earl of Rosse, the celebrated astronomer whose telescope at Parsonstown was for a long time the largest in the world. Mr. Parsons is thus the distinguished son of a distinguished father, and as inventor, or perfector, of the marine steam turbine he is now one of the most prominent figures in modern engineering. Mr. Parsons was educated by private tuition and at St. John's College, Cambridge. The biographical brevity, "Scholar 1873; 11th Wrangler 1876," attests the distinction he won. While working hard at his studies he did not neglect the physical culture without which the mind cannot achieve its full stature. The first L.M.B.C. boat had no stauncher oarsman than the subject of this sketch, and his example may be pointed to profitably at a time when the doctrine of "cram" is perhaps too prevalent. (*It also justifies the basic policy of the Rhodesian Scholarships.—Ed. P.*)

Having achieved so much distinction at his university, it was only fitting that Mr. Parsons should be elected a member of the Royal Society (1898), when his great contribution to the evolution of mechanics, although still in its infancy, had been proved a practical invention. Mr Parsons is a director of the Newcastle and District Electric Lighting Co., the Cambridge Electric Supply Co., Ltd., and the Scarborough Electric Supply Co., Ltd., in addition to the important offices already mentioned. But all other honours and activities must give place to his position as the sponsor of the Marine Steam Turbine, albeit that innovation has an ostensible history of less than a decade. By "ostensible" I mean that it is only nine years since the *Turbinia* made that marvellous dash of forty miles an hour round the fleet at Spithead, on the occasion of the Diamond Jubilee of Queen Victoria. That epoch-marking incident introduced a new feature into practical mechanics, although we may be certain that the little vessel, in spite of her meteor-like appearance and performance, was not the result of a lucky guess, but rather the outcome of many years of patient experiments and searching investigation. From that first, I might say sensational, public performance of the *Turbinia* the progress of the engine has been always steady; latterly, it has entered upon a triumphal march. The *Turbinia* was only 100 ft. long, the *Lusitania*, the mammoth Cunarder, is nearly 800 ft. long. The *Turbinia* was engined up to 2300 h.p; the *Lusitania* will be engined up to nearly 70,000 h.p. That is an extraordinary advance in a decade. There is nothing like it in the history of mechanics.

It must be remembered that the reciprocating or piston engine had been the subject of a century's experiments and improvements when the turbine challenged it on even terms. I am aware that the whole of the turbine case is not admitted by all engineers; indeed I am acquainted with some, whose opinion I value, who stoutly dispute the turbine's superiority. But I think there are few would deny Mr. Rankin Kennedy's carefully weighed declaration that, whatever may be in store for the turbine, the piston engine has now reached finality in that form. In order to introduce a short sketch of the present position and probable future of the steam turbine I shall briefly indicate its history in the last decade.

The *Turbinia* having demonstrated the practicality of the invention she was succeeded by the gunboats *Viper* and *Cobra* and, these having met with mishaps, timid soothsayers prophesied evil for the turbine. In spite of their jeremiads the engine was installed on the Clyde steamer *King Edward*, built by Messrs. Denny Bros. of Dumbarton. That was the first start of the Steam Turbine for use in commercial steamers. Speaking at the annual dinner of the Institute of Marine Engineers in the Liverpool Street Station Hotel, London, on October 19, 1904, over which he presided, Mr. Parsons said, "If the *King Edward* had not been launched I should probably not be here to-night." In the year which followed the advent of the *King Edward*, the *Queen Alexandra* was added to the turbine list by the same firm, and several improvements were introduced which added to the speed of the vessel without increasing proportionately the power of her engines or her coal consumption. Then more gunboats were turbine-engined; private yachts followed the lead; the Royal Navy joined in with larger ships, and while the first turbine cruiser, the *Amethyst*, was only 9800 h.p, the turbine *Dreadnought*, launched a few months ago, will be the most powerful warship afloat. Meantime the commercial progress of the turbine was not less of the leaping and bounding character. The Anglo-French cross-channel service followed the example of the Clyde, and in turn was followed by the Irish and English Channel boats. Long-distance steamers to Australia and New Zealand took a hand in this wonderful game (the *Loongana* proved very satisfactory) and the attack on the Atlantic was led by the Allan Liners *Victorian* and *Virginian*. In the last phase, it is true, fortune proved unkind for a time, and the turbine's future seemed to have passed under a cloud. But the cloud since then has cleared away, and the sun of destiny shines as strongly as ever on the new engine.* With the launch of the *Lusitania* most progressive marine architects and engineers have agreed that at least for fast passenger steamers the day of the piston engine is passing, and will soon have passed, like so many of man's inventions, into the void of things that have been.

This matter of fast steamers is important, for it is a limitation of the turbine in its present development that it is not a profitable engine for a slow ship. This—a single limitation—namely the high speed necessary if the turbine is to show its best efficiency, was accentuated by Mr. Parsons himself at the dinner above mentioned. The steamers sailing under the British flag, he stated, represented 9,000,000 h p. "The turbine in its present stage might be applied to nearly 3,000,000 h p.; the remaining ships are too slow for it to be applied to at the present time. The relative horse-power of machines that have been made, are working, or on order is about 340,000 h.p." In his presidential address to the same society (the Institute of Marine Engineers) at Stratford in January 1905, Mr. Parsons put the matter of high revolutions in the piston and turbine engine very succinctly: "The high revolutions which we dread in the reciprocating engine are a boon with the turbine, where bearings and thrust bearings are automatically lubricated, and the higher revolutions mean smaller screw shafts and propellers, and less weight on the tunnel blocks." Another feature is the deeper immersion of the propellers, owing to which even turbine yachts can cross the Atlantic in heavy weather without any perceptible racing of the engines.

As regards the turbine's future, Mr Parsons has no fears. In vessels of 16 knots sea-speed and upwards, and of over 5000 indicated horse-power, he is confident that it will soon entirely supersede the reciprocating engine; and this limit will possibly include before long vessels down to 13 knots of 20,000 tons and upwards. Even slower ships may be brought into line later, and although only in its early infancy the turbine would now be suitable for one-fifth the total steam tonnage of the world. This is a striking object-lesson on the rapidity of the march of modern mechanics.

It is interesting to learn that Mr Parsons thinks it probable a combination of the reciprocating and turbine engine will be found the best machinery for vessels of the "tramp" class in the immediate future. This field is a large and important one, and fills an extremely useful purpose in commerce, besides supplying our best sea story writers with an effective *mise-en-scene*. In a slow vessel it is manifest the revolutions must be slow because a certain disc area of propeller and a certain number of square feet of blade area are necessary in order to avoid too great a slip ratio, and consequent loss of propeller efficiency. The highest revolutions possible must be accepted but these in say, a 10-knot ship are but a low figure. From technical reasons into which I need not enter here, the turbine is not highly efficient under these conditions. But the turbine can deal economically with very low-pressure steam, and in the ordinary "tramp" the steam, although usefully expanded down to about 7 lb. pressure absolute, is then released into the condenser, and the remaining energy, down to about 1½ lb, is almost entirely lost. The turbine picks up 70 per cent. of this waste product, as I might call it, and turns it on to help in the driving of the ship. Mr Parsons is very clear and also very confident on this really wide field for turbine employment, and on this phase of the subject I may make yet another quotation from his presidential address,

"The additional power gained by the use of this low-pressure turbine has been calculated to be between 15 per cent. and 20 per cent. of the whole now realised—a gain of the same order as was obtained in the advance from the compound to the triple engine. This is the main feature of the case; minor points, of course, there are, such as improvements of the condenser (as a good vacuum is very essential to all turbines for the best results) and also feed-heaters fed from the exhaust of auxiliaries, or low-pressure steam drawn from the main engines for heating the necessarily colder feed. And there are also other minor points; but I am sure that some arrangement, such as I have endeavoured to indicate, will be largely used for the "tramp" engines of the near future."

There is still another new field for the marine steam turbine, and in it a beginning has now been made, namely, the propulsion of torpedoes. In some respects the United States Bliss-Leavitt turbine torpedo is much like the Whitehead, but it far surpasses its prototype in speed, range, and accuracy. While the Whitehead goes 1200 yards at 28 knots, and up to 2000 yards at 22 knots, the Bliss-Leavitt goes 36 knots up to 1200 yards, and 28 knots up to 3500 yards. The new torpedo is being made in two sizes. One is 18 in., which can be fired from the 18-in. tubes on existing battleships and torpedo-boats; the other will be much more powerful, the size being 21 in. The engine employed for the propulsion of this miniature war ship is the Curtis turbine, compound type, with two propellers adapted to run in opposite directions. The turbine runs at 10,000 revolutions a minute, geared down to 900 revolutions for the propellers, and at this speed the new torpedo developed 40 knots, although the contract was only for 36. A turbo-gyroscope is driven at a speed of 18,000 revolutions per minute, and by this ingenious invention the torpedo is prevented from deflecting from its course.

I believe most engineers admit that an "internal combustion" turbine would be an ideal machine, and although there are difficulties in the construction of a satisfactory gas turbine, scientific invention has not yet said its last word on the subject. Heinrich Zoelly of Zurich has patented a gas turbine which is said to be a good machine, but I am not acquainted with its design or results. Last year, Emil Capitaine installed a producer-gas turbine engine on a little vessel 60 ft. long, and during a ten hours' run, at 13 knots, only 467 lb. of anthracite were consumed, at a cost of about four shillings.

* Since the above was written the *Virginian* has broken by several hours all previous records between Rimouski and Moville.