which he referred the protecting influence exerted on the rails in use on railways. ib.

Notice of a Gas Furnace for Organic Analysis. By Dr. PERCY.

This was an ingenious arrangement, by which gas burnt, mixed with air, through wire gauze, was substituted for charcoal. Its advantages are its extreme cleanliness, and the power which the operator possesses of regulating, at will, the heat,—which is not practicable in the ordinary furnace for organic analysis with charcoal. ib.

On the Sailing Powers of two Yachts, Built on the Wave Principle. By Dr. PHIPPS.

The first was built for Dr. Corrigan, of Dublin, in 1844; a small open boat 24 feet by 6, of $3\frac{3}{4}$ tons, which did so well that she was able to beat everything near her own size, and to sail with those which exceeded it in some instances as far as four times. She was dry on seas where they were wet, was very stiff, sure in stays, and steered well at all times. The second is a yacht of 45 tons, O.M., for Samuel Holder, Esq., of Ringabella; built from the drawing by Mr. Peasely, of Passage West, in Cork. She appears to have the following qualities: a first rate performance, attained without sacrifice of any good quality, large accommodation, high stability. She is weatherly, steady, and easy, dry in the worst weather, and pitches and ascends less than any vessel I was ever in. She turns so sharply that no ten ton yacht can do it quicker, and steers so well, scudding in a gale of wind, that notwithstanding an unbalanced state, from an injudicious shift of mast, she neither broaches to, nor is compelled to lay to—which a companion of larger size (60 tons), and of tried sea qualities, was forced to do, and, in consequence, arrived from Cork to Dublin 14 hours after the wave-built yacht. In a race at Kingstown for the Railway Cup of 100 guineas, in which she was matched against the best boats of the three countries, in a time race, including one fine yacht of 100 tons, she won—and did the course exactly in 4h. 22m. 58s.—it being 46 nautic miles. Making no allowance for tacking or starting from absolute rest, the rate of this is $10\frac{1}{2}$ knots per hour. This is a great result for a principle yet in its infancy. The same vessel left Holyhead in a gale of wind, with storm-sails, main sail stowed, and everything made snug; with a reefed try-sail, a double-reefed foresail, and third jib. She lay in one stretch to the Irish coast, where she tacked to the southward, beating down to the Arklow light in 11 hours. Six persons on board, being separately questioned, agreed that the time from Holyhead to the Irish coast was $4\frac{1}{2}$ hours. Making every reasonable allowance, less than 50 nautic miles could not have been done; and this gives a velocity of 11 nautic miles per hour,—an unrecorded speed for ships of any size, close hauled, but surprising for a vessel of 45 tons, and in a very rough sea. It was, in fact, remarked on

board that, as the wind freshened, her pace increased without limit. This agrees with the fact stated by Capt. Fishbourne, of the *Flambeau* steamer, on wave lines, that she had a speed greatest in the worst weather, as compared with her rival.—It is perhaps possible to improve sailing vessels greatly, as compared with steamers. When so improved, they might be used where sailing vessels nearly compete with steamers at present. This may be further helped by the diminution of insurance and of the present unnecessary waste of human life.

Mr. Scott Russel, after expressing his gratitude to the Association for directing its attention to so important a subject, proceeded to explain the theory of what was known as the wave principle in ship building. He was first induced to direct his attention to this subject when the canal companies proposed some years ago to establish swift boats that might compete with the mail coaches. On being applied to by them, his first attempt was to build one with a spheroidal bow, produced by the revolution of an ellipse; but the result was not as successful as was to be wished. The favorite shape of bow among seamen at the time was that called a duck's breast, but the effect was to raise a large wave immediately in front of the vessel, which of course considerably retarded its velocity. He then directed his attention to the motion of the water itself. When a vessel passed through the water at a great velocity a high wave was raised at the head, as high in the old steamers as four feet; and this wave on falling back formed a hollow by its pressure immediately behind it, and the water was afterwards sent out with great force on both sides of the bow. All this was a costly and useless expenditure of force. He thought that, in removing the particles of water to allow the vessel to pass, it was necessary to expend the least force on the whole; and, therefore, the first impulse should be given gently. This force should increase to a certain point, and then decrease as gradually, leaving the particles to rest quietly at the greatest breadth. In endeavoring to ascertain the least resistance necessary to bring the particles of water out of a state of rest he conceived that there ought to be a similarity between the motion of water and that of a pendulum revolving in a circle according to the curve of the vessel's size; and this led him to adopt the form known as the wave principle. This is different from a bow formed of two straight lines meeting at an acute angle; it being gently hollower than such a bow towards the cut-water, and a little rounder towards the greater breadth. The object to be attained was, he conceived, to remove the particles of water rapidly, and at the same time not to throw them farther aside than the breadth of the vessel amidships. That this object was effected by the wave principle he ascertained in the following manner:—He got his model boat, 75 feet long, to be carried along by high-bred horses at a speed of 17 miles an hour, and made the head pass between two oranges floating on the water, and which he intended to represent two particles of the water to be removed. The oranges merely touched the side of the vessel until they got amidships, and there remained; thus showing that no greater force had been applied

to them than was necessary to remove them out of the way of the vessel. Another phenomenon observed was, that, instead of the high wave at the bow, which sailors thought was a sign of a ship sailing well, or what they called carrying a bone in her teeth, the elevation and subsequent depression of the water were entirely got rid of. In their place there was a gentle, long elevation, just under the shoulder of the vessel, where all sailors would like her to be supported. For the closing of the water at the stern he at first thought it would be better to have the same shape behind; and this had the effect of bringing the oranges together again behind in an horizontal direction; but he found it did not answer at all. It occasioned too high a resistance, and had a multitude of bad qualities. He discovered, in fact, that the fuller she was behind, and the flatter she lay upon the surface of the water, the quicker she sailed; and that this should be the case is clear, when it is considered that the water, returning to its level, is governed by an entirely different law from that by which it is first separated. The power which sends the water into the wake has nothing to do with that which displaces it before. It is forced upwards by the greatest pressure from below in vertical lines of the cycloidal family. A run fine below and full above was attained, by many experiments, as the best for good steering and other qualities. This full water-line above should never exceed a cycloid. The vertical lines, in which the water rises in the secondary wave (which really replaces the displaced water) may be cut off, at any convenient height, close to the stern. These two considerations united led him to the adoption of what is known as the wave principle. In the wave formation the greatest breadth of the ship is not at the bows, or even amidships, but a great way aft, in the ratio of three to two. In the shear plan the bow of this form has one main cycloid, and all the other bow lines are parts of cycloids. In this form the particles ascend and descend without shock.

Mr. Vignolles asked if the Admiralty had got vessels built on this principle,—*and if not, why not!*

Mr. Scott Russel replied, that he had been much more desirous for the adoption of the system in other ships than in the Admiralty, because he had been informed that the Admiralty did not like the introduction of scientific principles into ship-building, and preferred remaining as they were. He had, therefore, been averse to obtrude the subject on them. He might state, however, that the best informed men, at the Admiralty, were aware of the existence of the wave principle; and it was not improbable they might adopt it, though he could not say how soon, nor to what extent.

Ib.

Account and Description of Chemotype Printing.

Those who are aware of the deficiencies still existing in the practice of wood-engraving will gladly receive the intelligence of a newly invented art, which, though unlikely to supersede wood-engraving altogether, may certainly remedy the imperfections to which it is sub-