ON SOME REMARKABLE CHANGES PRODUCED IN IRON AND STEEL BY THE ACTION OF HYDROGEN AND ACIDS

FOR a long time it has been well known to wire-drawers and other manufacturers, who free the iron or steel they are engaged in working from rust by cleaning it with sulphuric acid, that after this process the metal becomes much more brittle than before. Further, if a piece of iron wire that has been cleaned in sulphuric acid be bent rapidly to and fro till it is broken, and the fracture be then moistened with the tongue, bubbles of gas arise from it, causing it to froth. If this same wire be now gently heated for a few hours, or left in a dry warm room for some days, it will be found to have regained its original toughness, and not to froth when broken and the fracture moistened.

Some experiments made by the writer on this subject during the last three years, have shown that not only sulphuric, but hydrochloric, acetic, and other acids which give off hydrogen by their action on iron, produce the same effect, making it probable that hydrogen is the cause of the change. This view is confirmed by collecting the gas given off at the surface of the iron and burning it, when the characteristic flame of hydrogen is seen.

Putting the facts together, it seems probable that a portion of the hydrogen generated by the action of the acid on the surface of the iron is occluded and subsequently given off, either rapidly, as when the iron is heated by the effort of breaking it causing the water on the surface of fracture to bubble, or, more slowly, in the cold.

Perhaps the simplest way of charging a piece of iron with hydrogen is by laying it on a sheet of zinc in a basin of dilute sulphuric acid. An electric current is here set up, and the hydrogen generated by the action of the acid on the zinc is given off at the surface of the iron. In this way two minutes or even less will often suffice to charge a piece of iron with hydrogen and alter its properties as completely as one hour's immersion in dilute acid without the zinc.

The change in the properties of iron which has occluded hydrogen is not confined to a diminution of toughness, though this may be reduced to one-fourth, but is accompanied by a remarkable decrease in tensile strain, amounting in cast steel to upwards of twenty per cent. after twelve hours' immersion in sulphuric acid. With iron wire the decrease in tensile strain was found to be less than with steel; the reduction amounted however in some cases to six per cent. Some interesting differences are noticeable in the relative effect of occluded hydrogen on mild steel and highly carbonised steel, the diminution of tensile strain after occlusion of hydrogen being greater in the latter case than in the former.

As with the metal paladium, so with iron, the electrical resistance is increased somewhat by occlusion of hydrogen; in fact, it seems probable that every property of iron or steel undergoes a change after the occlusion of hydrogen, and the extent of this change becomes a matter of great interest to the engineer now that iron and steel are so largely used.

Cases of the deterioration in toughness of iron of excellent quality exposed to the action of gas containing acid, as in the upcast shaft of a coal-pit, have come before the writer's notice, in which the change appeared to have resulted more from hydrogen occluded by the iron than its corrosion by the acid vapours. It is also probable that rapidly rusting iron occludes hydrogen, and is thereby weakened in strength and toughness.

WILLIAM H. JOHNSON

THE SOUTHPORT AQUARIUM

THE grounds of the Southport Pavilion, Winter Gardens, and Aquarium Company occupy an area of about nine acres, extending from a portion of the sea-wall and parade, on which they have a frontage of 1,110 feet, to Lord Street, the chief thoroughfare of the town, which runs in a straight line, roughly parallel to the sea-coast, for nearly a mile.

Entering the pile of buildings, which occupy about the centre of the grounds, by the chief portico on the Lord Street side, and ascending a wide flight of steps, the Promenade Hall is reached, which is constructed of pitch pine, and is over the principal corridor of the aquarium, to which access is obtained by descending a flight of steps, or an incline, placed on either side of the staircase leading up to the hall, which, like the corridor beneath it, is 160 feet in length by 42. To the right of the hall, and separated from it by glass doors, is the Band Pavilion, which is said to be capable of holding 2,000 people; round it is a gallery used as a promenade, and in which pictures are exhibited, and beneath it is the refreshment department, which is on the basement level. Like the aquarium,* the Pavilion is oval in shape, the longest axis being 136 feet, the shortest 76. To the left of the great hall, glass doors give admittance to a glass conservatory, 174 feet in length by 74, stocked with tropical and subtropical plants and birds; beneath it are the remaining corridors of the aquarium.

The first corridor of the aquarium contains twenty-three tanks, the front of each consisting of three sheets of plate glass, as at Brighton; and the light, as there, is all transmitted either through the water in the tanks or through plates of opaque glass placed in the floor above. The roof consists of double groined arches, supported on moulded columns, made of concrete, which has been largely used in various parts of the building with good results.

Tanks 1 to 23 contain: Sea Anemones, Nos. 7 and 23; Octopi, 11 and 21; Crabs, Spiny and Common Lobsters, 10, 16, 19, and 22; four specimens of King Crabs, 20; Conger and Common Eels; Salmon Trout; Ballan Wrasse, 6; Rough Hound and other dog-fish; Cod and Rock Cod; Grey, Streaked, and other Gurnards; Whiting, Soles, Plaice, Bret, &c.; Father Lasher (*Cottus scorpeus*), 4; two specimens of the Angel or Monk Fish, 15.

By the side of the tanks, plates of fishes from Yarrel's work are hung, which, not always having any connection with the living fish exhibited, rather distract attention, and would be better collected together with various stuffed fish placed at the top of the tanks, and placed in a small museum. Amongst the plates are some original coloured drawings of Mr. Jonathan Couch, of seven species of sharks, signed "J. C., 1825"; also eight drawings of flying-fish, by the same.

Corridor No. 2 has a flat ceiling supported on iron columns, is lighted by windows looking on to the garden on the Lord Street side, and contains table tanks, rectangular and octagonal, the former being filled with fresh water, the latter with salt, containing, amongst other things, several species of *Serpula, Sabella, Terebella, Amphritite, Aphrodita aculeata,* and other annelides; Sea Anemones of various species; *Thyone papillosa,* and other *Holothuriadæ; Ascidiæ* and other tunicated molluscs; various species of Starfish, *Cidaris;* Norwegian Lobsters; Blennys, fifteen and three spined Sticklebacks, and large numbers of living zoophytes. Several of these tanks, both in the beauty of their varied contents and the care with which they have been selected and arranged, afford a good example of what can be done by art to reproduce a portion of the richness of effect of the actual sea-bottom.

On the right or seaward end of this corridor there is a Seal Tank, five seals living in it and in the Seal Pond in the garden between the entrance lodges and the portico of the Promenade Hall. On the opposite end of the corri-

* The ground slopes from the sea towards Lord Street, so that the aquarium is underground on the seaward side. In my "Notes on the Geology of Liverpool," NATURE, vol. ii. p. 390, I have described the sand dunes, &c., of this coast.

dor is a very large tank (24), containing a large number of freshwater fish given by Mr. T. R. Sachs, of the Thames Angling Preservation Society. In tank 25 are Sea Perch; and in tank 27, which occupies the entire side of corridor No. 3, being no less than 63 feet in length by 14 feet in width, with seven feet of water, are a large number of full-sized dog-fish, a perfect shoal of large cod, and a Monk Fish more than five feet in length.

The aquarium in this direction is capable of almost indefinite extension, should the present success of the Company be maintained.

The sea-water for the aquarium is obtained from the Baths Company, who draw their supply from a point in the channel near the end of the pier, which is more than 1,400 yards in length. The water is received in a large storage tank under the conservatory, from which it travels through the various tanks, returning to a lower storage reservoir, from which it can be pumped back into the upper one, not less than 150,000 gallons of water being in constant circulation. As at Berlin and Brighton, compressed air is forced into the tanks, through indiarubber pipes; and Mr. Lloyd's plan of putting oysters into the tanks, introduced at Brighton, is adopted. The tanks, as well as the rest of the building, including the conservatory, are lighted at night by gas.

In the existence of large aquariums at Southport and Brighton, the ideas so long advocated by Messrs. Carl Vogt, Milne-Edwards, and Dr. Anton Dohrn, for the establishment of zoological stations, have to a certain extent been realised in England; but before they can be made available for original observation and research, laboratories must be built, and depot stations established at a few points on the coasts of Ireland and Scotland. Moreover, other large expenditures of an eminently uncommercial character must be incurred, which will never be entertained by commercial companies; but these, on the other hand, would probably not object to afford facilities for study if the necessary funds were found by those colleges, universities, and learned societies that prosecute the study of biological science.

CHARLES E. DE RANCE

NOTES

THE Eclipse Expedition arrived safely at Point de Galle on March 15. The Indian observing party proceeds to Nicobar Island by the *Enterprise*, which left Calcutta on the 11th inst.

AS we have already intimated, the Faraday Lecture of the Chemical Society will be given to-night in the Theatre of the Royal Institution by Dr. Hofmann, of Berlin, on "Liebig's Contributions to Experimental Chemistry."

THE service of meteorological telegrams to the ports of France was resumed on the 1st inst. The arrangements now in operation are as follows:—A large placard is sent down to be posted up in some public place, containing two specimen daily charts of the weather, and some simple rules for interpreting them. There are three blank spaces at the foot of the placard, which are intended for the chart of the preceding day from the *Bulletin International*, which arrives by post, and for two forecasts, morning and evening, which are to be transmitted by telegraph daily. It does not appear that there is to be any provision for exhibiting signals for the purpose of giving warning of storms. At present the only such signals which are apparently in use on the French coasts are those hoisted by the authorities of the Marine Ministry, from Dunkirk to Nantes, on the receipt of warning telegrams from London, and those hoisted south of Nantes, on the coast of the Bay of Biscay, on the receipt of orders from the Préfêt Maritime of Rochefort.

THE French Telegraphic Administration has appointed two delegates to examine, in common with the Board of the Observatory, what steps should be taken to collect by wire meteorological information, in order to send warnings to agricultural districts. The organisation of agricultural warnings will be one of the principal subjects of discussion at the forthcoming Paris Meteorological Congress.

M. MOUCHEZ, the chief of the St. Paul French Transit party, gave before the Academy of Sciences of Paris, at its sitting of the 15th inst., the first part of his report. M. Velin, the naturalist of the expedition, brought with him to Paris three living and a number of preserved specimens of all the species of the existing fauna, which is almost entirely marine. No landing could be effected on Amsterdam Island. Saint Paul and Amsterdam cannot be regarded as the remains of a shattered continent, but from their appearance and geological connection must have been elevated from the bottom of the ocean by individual volcanic eruptions.

WE learn from the *Saar und Mosel Zeitung* that we are liable to the importation not only of potato-beetles and Phylloxera, but even shells. About fifteen years ago some small shells were discovered in the Moselle near Treves, which were very different in form from the other native species. A few weeks back the discovery was made that the same locality now abounds in this new animal, as large numbers were found in a perfectly developed state. This seems to prove that the little ones, that were doubtless imported by some raft, have grown and propagated. It is stated that the real home of this species is the Sea of Azoff and the Black Sea, and it is remarkable that they inhabit both salt and fresh water.

THE *Kölnische Zeitung* reports that besides Phylloxera and the Colorado Beetle a third noxious insect has come over to Europe from America; it is the so-called Blood Louse, which causes much damage to apple-trees. As a practical remedy against this unwelcome guest, it is recommended to paint the young trees with naphtha and lime-water. With arger trees of course this is impossible; but it is said that if during winter a thin lime paste is placed in a circle round the tree where it comes out of the ground, the ova of the Blood Louse are then completely destroyed.

THE discovery is announced at the Pola Marine Observatory of Planet 143, by Director J. Palisa, with a telescope of $7\frac{2}{3}$ ft. focal length. It appeared of the 12th magnitude, and the ephemerides given are: 1875, Feb. 23, 8h. 42m. 12s. Pola mean time; R.A., 9h. 57m. 57s. (daily motion − 60s.); and Decl. + 13° 46′ (daily motion + 1′). Of the 143 asteroids, 97 have been discovered in Europe, 41 in America, and 5 in Asia.

THE celebrated physicist Amberg lately delivered three lectures at the "Volksbildungsverein" at Cologne, principally on the phenomena of Electricity, Optics, and Acoustics.

THERE will be an election at Magdalen College, Oxford, in June next, to at least one Demyship and to one Exhibition in Natural Science. The stipend of the Demyship is 95*l.* per annum, and of the Exhibition 75*l.*, inclusive of all allowances, and they are tenable for five years. Particulars may be obtained by applying to the senior tutor.

THE Council of the Senate of Cambridge University propose to offer a grace early next term for the appointment of a syndicate to consider the propriety of establishing a professorship of Mechanism and Engineering.

AMONG the papers appointed by the Council of the Institution of Naval Architects to be read at the meetings on the 18th, 19th, and 20th inst., are the following:—On the Telegraph ship *Faraday*, by W. C. Merrifield, F.R.S.; On a mode of obtaining the outlines of sea-waves in deep water, by W. W. Rundell; On the graphic integration of the equation of a ship's rolling, including the effect of resistance, by W. Froude, F.R.S., vice-president; On a method of obtaining motive