

what can be done with iron, and we have only to look at the new system of casing ships with armour plates, to be convinced that we can no longer build wooden vessels of war with safety to our naval superiority and the best interests of the country. I give no opinion as to the details of the reconstruction of the navy,—that is reserved for another place,—but I may state that I am fully persuaded that the whole of our ships of war must be rebuilt of iron, and defended with iron armour calculated to resist the projectiles of the heaviest description at high velocities. In the early stages of iron-ship building, I believe I was the first to show, by a long series of experiments, the superiority of wrought iron over every other description of material in security and strength, when judiciously applied in the construction of ships of every class. Other considerations, however, affect the question of vessels of war; and although numerous experiments were made, yet none of the targets were on a scale sufficient to resist more than a six-pounder shot. It was reserved for our scientific neighbors, the French, to introduce thick iron plates as a defensive armour for ships. The success which has attended the adoption of this new system of defence affords the prospect of invulnerable ships of war, and hence the desire of the Government to re-model the navy on an entirely new principle of construction, in order that we may retain its superiority as the great bulwarks of the nation. A committee has been appointed by the War Office and the Admiralty for the purpose of carrying out a scientific investigation of the subject, so as to determine—first, the best description of material to resist projectiles; secondly the best method of fastening and applying that material to the sides of ships and land fortifications; and lastly the thickness necessary to resist the different descriptions of ordnance. It is asserted, probably with truth, that whatever thickness of plates are adopted for casing ships, guns will be constructed capable of destroying them. But their destruction will even then be a work of time, and I believe, from what I have seen in recent experiments, that with proper armour it will require, not only the most powerful ordnance, but also a great concentration of fire, before fracture will ensue. If this be the case, a well-constructed iron ship, covered with sound plates of the proper thickness, firmly attached to its sides, will, for a considerable time, resist the heaviest guns which can be brought to bear against it, and be practically shot-proof. But our present means are inadequate for the production of large masses of iron, and we may trust that, with new tools and machinery, and the skill, energy, and perseverance of our manufacturers, every difficulty will be overcome, and armour plates produced which will resist the heaviest existing ordnance.

We have already seen a new era in the

history of the construction of bridges, resulting from the use of iron; and we have only to examine those of the tubular form over the Conway and Menai Straits to be convinced of the durability, strength, and lightness of tubular constructions applied to the support of railways or common roads in spans which, ten years ago, were considered beyond the reach of human skill. When it is considered that stone bridges do not exceed 150 feet in span, nor cast-iron bridges 250 feet, we can estimate the progress which has been made in crossing rivers 400 or 500 feet in width, without any support at the middle of the stream. Even spans, greatly in excess of this, may be bridged over with safety, provided we do not exceed 1800 to 2000 feet, when the structure would be destroyed by its own weight.

Amongst the changes which have largely contributed to the comfort and enjoyment of life, are the improvements in the sanitary condition of towns. These belong, probably, to the province of social rather than mechanical science; but I cannot omit to notice some of the great works that have of late years been constructed for the supply of water, and for the drainage of towns. In former days, 10 gallons of water to each person per day was considered an ample allowance. Now, 30 gallons is much nearer the rate of consumption. I may instance the waterworks of this city and of Liverpool, each of which yield a supply of from 20 to 30 gallons of water to each inhabitant. In the former case the water is collected from the Cheshire and Derbyshire hills, and, after being conveyed in tunnels and aqueducts a distance of ten miles to a reservoir, where it is strained and purified, it is ultimately taken a farther distance of eight miles in pipes, in a perfectly pure state, ready for distribution. The greatest undertaking of this kind, however, yet accomplished, is that by which the pure waters of Loch Katrine are distributed to the city of Glasgow. This work, recently completed by Mr. Bateman, who was also the constructor of the water-works of this city, is of the most gigantic character, the water being conveyed in a covered tunnel a distance of 27 miles, through an almost impassable country, to the service reservoir, about eight miles from Glasgow. By this means 40,000,000 gallons of water per day are conveyed through the hills which flank Ben Lomond, and after traversing the sides of Loch Chon and Loch Aird, are finally discharged into the Mugdock basin, where the water is impounded for distribution. We may reasonably look forward to an extension of similar benefits to the metropolis, by the same engineer, whose energies are now directed to an examination of the pure fountains of Wales, from whence the future supply of water to the great city is likely to be derived. A work of so gigantic a character may be looked upon as problematical; but when it is known that six or seven millions of money would be sufficient for its execution, I can see no reason why an undertaking of so much consequence to the health of London should not ultimately be accomplished.

Mr. Fairbairn concluded with a brief allusion to the wonders of the electric telegraph, the discoveries in photography, and the approaching Exhibition in London, which will embrace the whole circle of the sciences, practically illustrated, in a manner, and to an extent, such as the world has never before seen.

On the motion of Lord Stanley, a vote of thanks was moved to Mr. Fairbairn for his excellent address.

An unlooked-for accident has obliged us to put our correspondence this month in *minor* type.