INSTITUTION

OF

ENGINEERS IN SCOTLAND.

SESSION 1864-65.

Introductory Address. By MR. JAMES R. NAPIER, President.

Read 26th October, 1864.

AFTER a few introductory remarks the President said:—

As the members of the International Association have been working for years to get the moneys, weights, and measures of this country changed, and have so far succeeded as to get the use of the French metre legalised, and as their next move will no doubt be to get our present measures of length abolished, I think such an institution as ours would be profitably employed in discussing the subject, and, if possible, coming to a decision as to the expediency of the changes proposed.

The metre was intended to be the 10,000,000th part of the quadrant of the meridian passing through Paris. The International Association and others would make this the universal unit of length. Sir John Herschel has stated in his "Essay on the Metre, &c.," recently presented to the Institution, that the 10,000,000th part of this quadrant of the meridian is appreciably longer than the metre; that all quadrants of meridians are not of equal length; and therefore, that the arc passing through Paris has no claim over any other to special consideration; and that if a natural foundation is to be sought for a universal standard, the only one which can be so considered is the earth's polar axis. He finds that the British inch is very nearly the 500,000,000th part of this axis; and he says that if the present inch be made only 1,000th part longer, it would place our lineal measure on a perfectly faultless basis, and at the same time rescue our weights and measures of capacity from their present utter confusion, and secure that other advantage, second only in importance to the former, of connecting them decimally with that system on a regular, intelligible, and easily remembered principle, and that by an alteration practically imperceptible in both cases, and interfering with no one of our usages or denominations. The cubic foot of water at the standard temperature would then weigh exactly 1000 ounces, instead of 997·13 ounces as at present. The ounce and cubic foot would be the connection between weights and measures, instead of the grain and cubic inch; and as regards measures of capacity, the half pint under a new name would contain exactly 100th part of a cubic foot, with whatever liquid or solid matter it might be filled. He would legalise a measure containing fifty of these new inches, and equal to the 10,000,000th part of the earth's polar axis.

In that remarkable paper, "On the Reputed Meterological System of the Great Pyramid," Professor Piazzi Smyth has been led to conclude that the standard used by its builders was the 10,000,000th part of the earth's polar axis, and that it was divided into fifty equal parts or inches; that the sacred cubit of the Jews was equal to twenty-five of these parts. The standard and its divisions are therefore the same as that recommended by Sir John Herschel. It will indeed be strange, if it can be made out, as he and others are trying to do, that the Great Pyramid was built chiefly for the purpose of preserving the standards of length, weight, and capacity used four thousand years ago; and stranger still, if it should be true, that some of these measures are still used in Britain. The so-called quarters in which the British farmer up to the present day measures his wheat are said to be accurately quarters of the cubical contents of the porphery coffer of the king's chamber of the Great Pyramid; and from recent measurements of the old English ell, made for Professor Smyth, it appears that fifty of its inches are very nearly indeed equal to the 10,000,000th part of the earth's axis of rotation. Dr. Rankine, in a paper to the British Association at Bath, has stated that the British inch, or multiples of it, is used by one-fourth of the population of the whole earth. From these remarks it will be seen that the British inch, either as it is or as it was, has some claims to be continued as a standard of length which are not to be hastily set aside for the metre or its subdivisions.

A matter of considerable importance to mill-owners has recently come before me, in a paper by Mr. G. H. Strype, "On the Influence of the Inertia of the Reciprocating Parts of Steam Engines, &c.," read, in Feb., 1863, to the Institution of Civil Engineers of Ireland. The subject is not new, although I have only lately seen its importance: M. L. Chatellier published a similar analysis in connection with the stability of locomotives, in the year 1849. Mr. Strype states that the irregularity of motion produced by the difference of the initial and final pressure of steam in an engine working expansively is greatly overrated in the case of single cylinder engines; that the inertia of the working beam and other reciprocating parts of the engine becomes a regulating medium, such as is required for equalising on the crank pin the great difference of pressure on the piston between the first and last of the stroke, when a considerable amount of expansion is used. As the accelerating force of the reciprocating parts of the engine varies as their weights and squares of their velocities, a skilful mechanic will have very little trouble in so designing a new undivided expansion engine, with any given ratio of expansion, so that its motion shall be at least as regular as any other engine with the same ratio of expansion divided among two or more cylinders, and shall be more regular than many single cylinder engines with a less ratio of expansion. The simplicity of the single cylinder engine with undivided expansion recommends itself before any combination dividing the expansion among two or more cylinders. Mr. Strype had a favourable opportunity of comparing the economy of the single cylinder engine with the double cylinder engine. He states that a pair of single cylinder engines of 245 I.H.P. consumed 33 tons of coals per week, and that a double cylinder engine of 176 I.H.P. consumed 40 tons per week; or, calculating for equal amounts of power, the fuel for the undivided expansion engine was to that for the divided expansion engine as 1 to $1\frac{3}{4}$ nearly. Both engines were connected with flax spinning mills; both had boilers of the same number, construction, and dimensions; both had the same amount of expansion (4 to 1), and used the same quality of coals. It is not stated that the cylinders of either were cased with steam, or in any way heated. The loss in the divided expansion engine he ascribes chiefly to the waste in the passages.

In the remarks I sent last session to reopen the discussion on the effects of superheated steam, &c., I proposed, for the detection of the acid which I believed was the cause of the corrosion in marine boilers, the placing of pieces of polished marble in the steam and water, expecting that the acid would show itself by destroying the polish. I had six pieces placed in different parts of the *Lancefield's* boiler, and left them there for six weeks. The result was that the white marble from the water became yellow, and the shining polish was destroyed, but whether the latter was caused by a deposit from the boiler water or by the acid action which I expected, I cannot tell. The polished pieces taken from the steam space were not perceptibly changed either in colour or in polish. Thinking, then, that zinc would be as good a test of the presence of acid as marble, I had a piece about 4 feet long by 3 inches broad, by $\frac{3}{16}$ths thick, placed vertically, part in the steam and part in the water; it was in the boiler for three weeks. The lowest part, which was immersed about 18 inches, was greatly corroded, the corrosion decreasing up to the highest part, which, in the steam, appeared to be little affected. Lime was suggested as the cheapest remedy for this supposed acid action. I was afraid, however, to venture on the quantity thought to be necessary, viz., about 20 lbs. per hour, and tried only about 3 lbs. per hour. The effect was imperceptible, as shown by the corrosion of another similar piece of zinc placed in a similar position during another three weeks, the boiler primed with every addition of the lime. Whether the corrosion of the zinc is any indication of the preservation of the iron or otherwise I do not know. If it is, it has the appearance of being too expensive a remedy. I expect, however, better results from soda-ash, which I purpose trying again; but I feel the want of a delicate and ready test to show the effect at once, or without waiting for months, or it may be years, to find out perhaps that the remedy has made things worse. Mr. J. C. Foster has tested some of the condensed steam from the safety valve casing and from the cylinder jacket of the *Lancefield*, and found both decidedly acid.

During a voyage to the Mediterranean last spring, I tried to get some experience as to the rolling, &c., of the ship; but unfortunately the weather was too fine, the ship behaved too well, or I was too obtuse to profit much by the sea breezes. I had Professor Smyth's free revolver with me, and on several occasions recorded both the angles and times of rolling; but for want of other data my observations are, I believe, useless. From the frequent upsetting of one of the back rails of a cabin seat, I inferred that on these occasions the vessel rolled from the vertical about 30°; and the length of the waves, which I assumed to be the same as those I had measured when the wind was fair, about 300 feet. Professor Rankine from these data has calculated that the ship rolled to an angle about three times greater than the greatest slope of the waves. I was indebted to one of the passengers for making a glass bottle the end of my measuring line, instead of the piece of wood I had provided. With such an apparatus the lengths of the waves can be very accurately measured. Waves about 170 feet long travelled about 22 feet a second faster than the vessel at 11 nautical miles an hour. The height of these waves, judging by their rise and fall on the middle of the ship, I measured about 12 feet, and the largest about 13½ feet. It is stated by Professor Rankine, in explanation of some ships getting pooped, that the sea wave adds itself to the following wave created by the ship herself. Whether it be true or not that ships with full sterns are more frequently pooped than ships with finer sterns, I think it is evident that ships to be used where heavy seas are to be met with should have finer sterns than those for smoother seas; for besides the speed of a vessel being greater running before a gale than in smooth water, there is the backward current of the water in the trough of the sea to be allowed for. In the case of the waves 300 feet long to which I have alluded, this backward current at the surface of the water in the trough, calculated by the usual formula, would be from 2½ to 3 nautical miles an hour: so that the stern of a vessel intended for a speed of 10 or 11 miles an hour in such seas should be made suitable for a speed in still water of from 12 to 13 miles an hour. The wave current in the trough of the sea, travelling, as it does, in the opposite direction to that of the wave created by a vessel running with the sea, with a stern too short for the velocity of ship and wave current, may cause the ship's stern wave to break. Great masses of water frequently broke, when the stern was in the trough, under the quarters of the vessel in which I sailed. The waves were then travelling at the rate of about 23 miles an hour, while the vessel was following them at the rate of about 11. I expect this phenomenon is common enough in heavy weather, and that these may be the seas which poop vessels, small relatively to the waves, or larger vessels with sterns too short for them.

The question of "Great Guns *versus* Great or Little Ships," is still a subject of great interest. There has been a system lately proposed by Mr. M'Laine, of Belfast, which I expect will ere long recommend itself. Instead of turning one or more turrets enclosing small guns, as in Captain Cole's system, by hand or otherwise, Mr. M'Laine turns the whole ship by means of her propelling power; and proposes to fire monstrous guns from her well-protected bow. The vessel is to be propelled and manœuvred by two submerged propellers at the stern.

The President exhibited the pieces of marble and zinc referred to in his address, and expressed a hope that members would bring before the Institution the results of any experiments or observations they had made.