

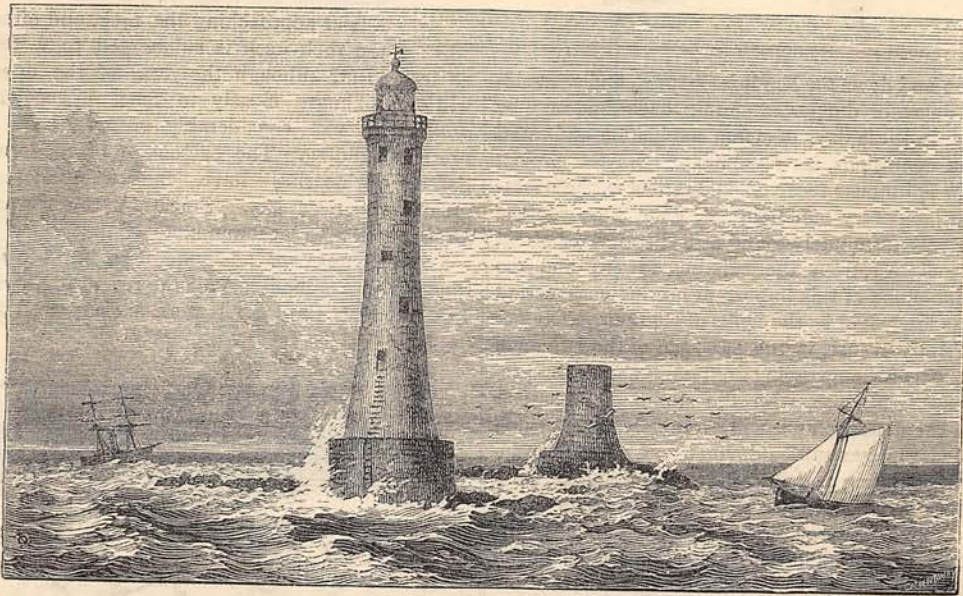
THE NEW EDDYSTONE LIGHTHOUSE.



THE story of the lighting of the Eddystone Reefs has recently, many of our readers are aware, entered upon a new and important chapter. Every school-boy knows the history of the two first lighthouses—Winstanley's and Rudyerd's—that were erected upon those dangerous rocks; and, better still, the story of the magnificent tower which, thanks to the practical genius and philanthropic enterprise of that father of the modern race of civil engineers, John Smeaton, has

the outer joints of the stones had been repointed with Portland cement; many of the courses had been re-bolted; and the projection of the cornice, upon which the upward stroke of the waves was found to act, had been reduced five inches; but all these measures were found ineffectual to insure the stability of the building, which, during heavy storms from the west and west-south-west, continued to oscillate to an alarming extent.

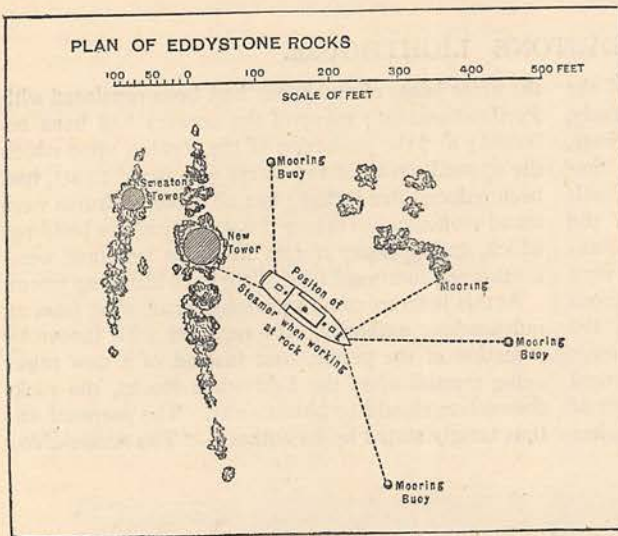
At this juncture came a proposal, emanating from an independent authority, and received with favour by a section of the public, that instead of a new tower being erected upon the Eddystone Rocks, the rocks themselves should be blown away. The proposal was thus tersely stated by its author:—"The *raison-d'être*



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safely stood, amid the wild surges of the Eddystone, "a pillar of fire by night, of cloud by day," for the past 120 years, and which its architect hoped, as his own words testify, might thus stand for all time. Herein, however, the "vanity of human wishes" has again been strikingly exemplified. The foundation of Smeaton's structure has, of late, shown serious signs of undermining; and the authorities of the Trinity House, acting on the advice of their engineer, Mr. J. N. Douglass, determined last year to erect, upon another and a firmer part of the Eddystone Reefs, a fourth lighthouse, to supersede the present one. That decision was not arrived at, as might be expected, until every practical expedient had been vainly tried for rendering Smeaton's noble and historical building secure. The whole of the upper part of the tower, from the lantern floor down to the solid portion of the masonry, had been strengthened by internal iron ties;

of the light is, no doubt, the reef; why not remove the reef?" And this alternative plan actually came before the consideration of Parliament. Putting aside, however, the immense expense attending such an operation as that contemplated—an expense estimated as seven times greater than that of building a new lighthouse, for 2,000,000 tons of rock would have had to be removed—the authorities of the Trinity House contended that the suggestion was gravely unpractical. "The use of the light," the authorities say in their report presented to Parliament, "is by no means confined to warning against an isolated danger, with whose removal its function would cease; but the existence of that danger, in affording a platform for the exhibition of a light, has become not merely the means of giving a good lead into Plymouth, but of determining position, and of providing an essential link in that chain of general passing lights which, as defining a straight

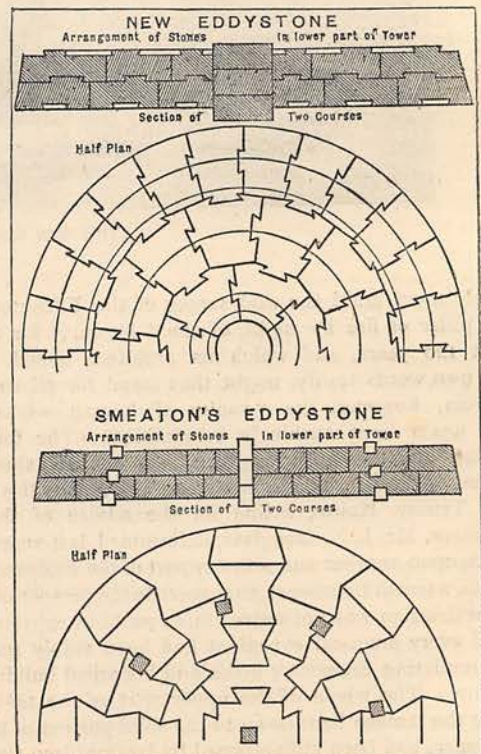


course up and down the English Channel, and so avoiding the delay or danger attending deviation, may be regarded, in these days of steam navigation and rapid maritime operations, as invaluable." So the project for a new lighthouse received, in due course, the necessary Parliamentary sanction. A good base for the building was fortunately found at a distance of about 120 feet S.S.E. from the existing tower; and the foundation-stone of this important marine-engineering work was lately laid by the Duke of Edinburgh, Master of the Trinity House, in the presence of the Prince of Wales. The accompanying engraving shows the proposed new lighthouse, with the stump of Smeaton's tower in the distance as it will eventually be left; and the following pages will be devoted to a short description of the building and the mode of erecting it; as a preliminary to which, let us speak of the rocks themselves. The Eddystone Rocks shown in our engraving are chiefly composed of three nearly parallel gneiss reefs, of from 300 feet to 600 feet long, situated from 100 feet to 150 feet apart. They lie, almost N. and S., fourteen miles to the S.S.W. of Plymouth, and about ten miles from Ram Head, which is the nearest point of land. The rocks are exposed to the heavy seas of the Bay of Biscay and the Atlantic Ocean; and, until the erection of Winstanley's lighthouse in 1699, were a source of great danger to the mariner, "many a good ship," to use the words of Daniel Defoe, "having been lost there in former times." The reef upon which the present lighthouse stands is the westernmost one. That upon which the new tower will be erected is the middle one. The site of the new lighthouse lies considerably lower than that of Smeaton's building, the foundation of the latter house having been laid near the level of high water, whereas the foundation of the new house will be laid below the level of low water.

The contour of the proposed building will not essentially differ from that of its predecessor. Modern lighthouse engineers get their form of rock tower from Smeaton, because Smeaton got *his* from nature, to which infallible teacher true architects are ever in-

debted for the most perfect types of beauty and of strength. The trunk of a large spreading oak-tree presented itself to the mind of Smeaton as the natural model of a column possessing the greatest stability; and this form has ever since been proved to be the most suitable for resisting the force of the terrific waves to which rock lighthouses are exposed. The cylindrical base, which our engraving shows, is however a novelty in the new structure. This base, the upper surface of which will be $2\frac{1}{2}$ feet above high water of spring tides, has been designed for providing an efficient landing platform for the permanent service of the light. By this arrangement the monthly reliefs of the keepers, and the supplying of the lighthouse with stores and provisions, will ultimately be possible whenever the state of the sea will admit of a boat approaching the rock, and often when the rock itself is submerged to a depth of

20 feet. But, although the *form* of the new tower will approximate closely to Smeaton's column, its *dimensions* will considerably exceed those of the present building. The exigencies of modern lighthouse engineering have, indeed, rendered this greater size necessary. Smeaton's tower was never large enough to accommodate a first-order lantern —*i.e.*, a lantern of adequate area for receiving a dioptric light embodying all the recent improvements. In Smeaton's time the lantern did very well for con-



taining the twenty-four large tallow candles which—hoisted on a chandelier, without any optical instrument for sending their beams seaward—constituted the best illuminating apparatus which scientific skill had then devised for guarding the mariner from the dangerous Eddystone Rocks. But in the present age when, owing to the great discovery of Augustin Fresnel, dioptric apparatus are manufactured to show an oil light having flashes of the intensity of 126,000 standard sperm candles (170 times the power of the unaided flame of the lamp) instead of the feeble light of only sixty-seven standard sperm candles, to which Smeaton's twenty-four large tallow candles are said to have been equivalent, a building of vastly augmented proportions is demanded.

The base of Smeaton's tower is 32 feet in diameter, and its light 72 feet above high water, with an illuminated range of fourteen nautical miles. Its rooms are four in number besides the lantern; each room being $12\frac{1}{4}$ feet in diameter; and it contains about 13,343 cubic feet, or 988 tons of stone. The base of the new tower will be 44 feet in diameter, and its light 130 feet above high water, with an illuminated range of $17\frac{1}{2}$ nautical miles. Its rooms will be nine in number besides the lantern; the seven uppermost being each 14 feet in diameter; and it will contain about 69,100 cubic feet, or 5,141 tons of stone. The present building cost £40,000; the new building is estimated to cost £78,000. It will thus be perceived that the calamity which has overtaken Smeaton's noble structure will prove in the end a blessing to the maritime community; and we do not doubt that, were its architect now alive, he would feel more than compensated for any natural disappointment he might experience at seeing his great work become a thing of the past, by the knowledge that in its place would be reared, though by another's skill, a building better adapted than his own to subserve the interests of that humanity which he loved so well.

The new lighthouse, like its predecessor, will be composed of granite, many of the blocks of which will weigh over three tons each. The tower will be solid—with the exception of a water tank—for $25\frac{1}{2}$ feet above high water of spring tides. At this point the rooms, arranged one above the other, will begin, the walls of the lowest of which will be $8\frac{1}{2}$ feet thick, and those of the highest $2\frac{1}{4}$ feet thick. The entrance door, which will be situated at the top of the solid portion of the tower, will be approached by gun-metal steps, let into the surfaces of the landing platform and the lighthouse; and internal iron ladders will be provided for the ascent from floor to floor. The external door and window frames of all the rooms will be of solid gun-metal, with panels of thick plate-glass. Some idea of the substantial character of these fittings will be conveyed when we mention that the entrance door alone will weigh over a ton.

The masonry of the tower is being dressed at Wade-bridge and Dalbeattie; and all the stones composing the same will be temporarily fitted or dry-set in sections, on a specially prepared platform in the work-yard. When found to be accurately shaped the stones

will be taken apart, properly lettered and numbered in red and black paint on the joints, and packed ready for transporting to the rock. The method adopted for dovetailing the stones one into the other, in addition of course to their being set with cement, is a most elaborate and successful one. A raised dovetailed band, 3 inches high, and of widths, varying according to the size of the stone, from 27 to 10 inches, is worked out of the solid block, and fits into a corresponding recess at every meeting surface of the adjoining stones. Our engraving shows both this arrangement of interlocking the blocks and that devised by Smeaton. Smeaton's system is, as will be seen, especially deficient *vertically* in comparison with that which is being applied to the new tower. He employed mere joggles and bolts for holding his courses one to the other, instead of the solid dovetailed band of granite. His method, however, as the germ of all subsequent ones, cannot but excite the highest admiration.

The vessel employed in conveying the working party and material to the rock is a rapid screw steamer of 120 tons, originally built for a similar service. She is furnished with steam winches and all the most efficient modern gear for rapidly taking on board and transshipping her own cargo, in readiness for being hoisted into position by the steam crane in the centre of the site of the new tower. How different, all this, from the facilities which existed for such purposes during the erection of the present lighthouse! Smeaton himself assisted, though in this respect he was eclipsed by Watt, in perfecting the "Newcomen" engine; but the great lighthouse-builder had been dead fifteen years before (in 1807) Robert Fulton's boat, the *Clermont*, steamed successfully up the Hudson. Small sailing vessels—herring boats, or *busses* as they were called—were, therefore, the best craft obtainable for conveying the material, of Smeaton's tower from Millbay to the rock. These vessels were completely at the mercy of wind and weather, and used to beat about for days and sometimes weeks before reaching the Eddystone.

The preliminary work of erecting the new lighthouse consisted in the cutting and levelling of the rock into benches for receiving the bottom courses. The foundation of the building being, as already stated, below the level of low water, it was necessary, in the first place, to construct a brick and cement cofferdam, inside which the men could proceed safely with their boring and cutting operations—and eventually with the setting of the lower courses—for the brief three or four hours that constituted a usual tide's work. In these operations no gunpowder was allowed to be used, for fear of shaking the adjoining rock; the whole of the cutting and levelling being accomplished by tools known as "jumpers," assisted by a patent rock-boring drill, which was worked by compressed air from the boiler of the steam vessel. The preparation of the site for receiving the foundation courses, inclusive of the construction of the brick dam, has occupied the workmen about a year, which represents, however, only about forty days, of nine hours each,

continuous time ; so rare, and of such short periods together, are the available landings on the Eddystone.

Where the bottom courses come into contact with the rock, thereby interfering with the system of dovetailing already described, each stone, besides being set in cement, is to be secured to the rock by two 1½-inch Muntz metal bolts passing through the stone and nine inches into the rock below. Each end of the bolt will be sawn down the centre to a depth of six inches, and a Muntz metal wedge driven into the slit. The ends of the bolts will thus be expanded, and any movement after their insertion prevented. Above the rock no bolting will be required.

The authorities of the Trinity House have not yet decided on the character of the light which will be shown from the new tower. We are, therefore, unable to describe the lantern and illuminating apparatus that will be employed. Otherwise our article has, we believe, touched, however lightly, most of the principal points of interest in connection with our subject.

That the new building, when completed, may be instrumental in preserving from the ocean's "vast and wandering grave" as many human lives as its predecessor, must be the sincere wish of every reader of these pages.



OUR ECONOMICAL GAME-DISHES.

ANY skill I possess in dressing game was acquired long ago, during a season spent at my brother's shooting-lodge in the mountains near Dungiven. There was no secret made of the reason why the privilege of a residence at the Lodge was accorded me.

"Margaret will be very useful as our cook ; so, mother, you must spare her," said Jack and Alfred.

I liked the thoughts of the expedition, and hastened to pack up cooking implements, and seasonings. I took with me two or three brace of grouse that had been hanging in the larder for a fortnight, and when, on our arrival, Jack drew them out of the hamper, exclaiming, "Why, Margaret, how foolish to bring coals to Newcastle in this way!" I was able to reply with dignity, "You declared that you would eat nothing but game, and I knew that you could not eat grouse newly killed."

"You're a brick!" replied both brothers, while their friend, Mr. Hastings, looked at me with an expression which I interpreted as one of admiration.

"Instead of talking Tennyson, as you and Hastings have been doing," proceeded Alfred, "suppose you explain your views upon the subject of cooking a grouse."

"Certainly! A grouse must hang with its feathers on for ten days or a fortnight before being used, else it will not be tender. These were killed on the 12th of August, and will be capital if I roast them properly."

There was a *sotto voce* assurance from Mr. Hastings that anything prepared by my hands must be excellent ; but I took the assurance for what it was worth. Biddy Freel, the mistress of a cabin near the Lodge, who swept our rooms and carried water and turf for us, came in as I was plucking and drawing the grouse just before putting them to roast.

"Dear, dear!" she cried. "What work is that for a lady like you! Gie me the bird. Sure I ha' made ready chickens in my time."

She watched me closely while I wiped the grouse

