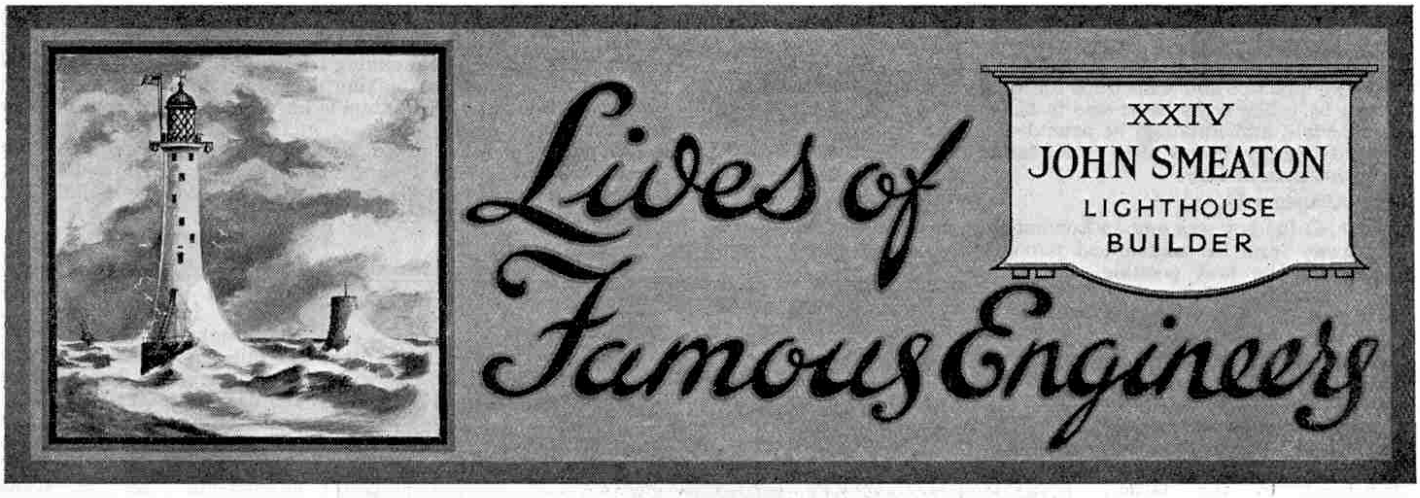
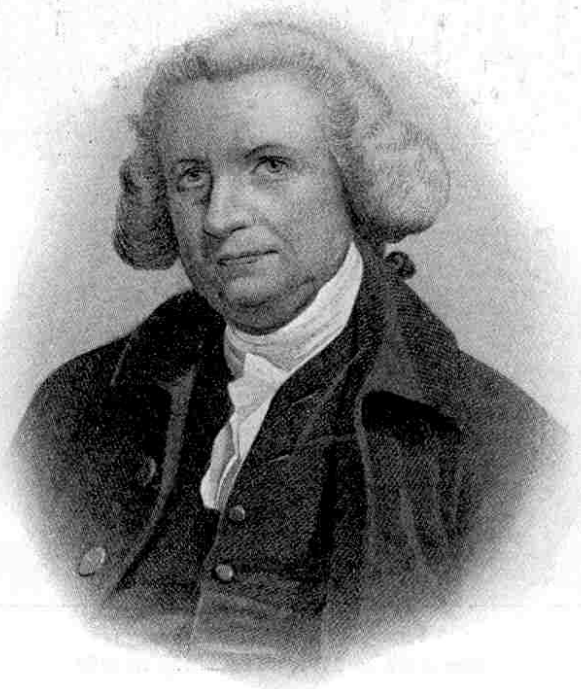


JOHN SMEATON was born on 8th June, 1724, at Austhorpe Lodge near Leeds, in which city his father practised as a solicitor. At that time Leeds was a place of comparatively small importance. The principal streets, which still exist under their old names, were Briggate, leading to the bridge, Kirkgate leading to the parish church, and Swinegate leading to the old castle. Beyond these streets lay open fields. Boar Lane, which is now in the centre of the present-day city of nearly half-a-million inhabitants, was a pleasant suburb in which lived the principal merchants. Austhorpe was then quite in the country, the only houses in the neighbourhood being those of the tiny hamlet of Whitkirk and the neighbouring mansion of Templenewsam.



John Smeaton

Boyhood days

From his earliest years Smeaton displayed unusual thoughtfulness and powers of observation, and the ability, not only to take his toys to pieces, but to put them together again successfully. The only toys in which he appeared to take any real pleasure were his models of things that would work, and he was perfectly happy so long as he had any kind of cutting tool with which he could make little models of pumps and windmills. He never lost an opportunity of watching the operations of carpenters, masons, or other workmen who happened to be employed in the neighbourhood. He observed closely how they handled their various tools and implements and frequently asked questions in which he showed so much intelligence that the workmen gave him serious and careful answers.

No sooner had the boy thoroughly grasped the methods by which workmen carried out a certain task than he began to attempt similar operations in miniature. Sometimes this habit upset the feelings of the family, as on the occasion when, after watching some millwrights at work, he was discovered on the top of his father's barn busily engaged in fixing a wooden mill-like structure!

These free-and-easy childhood days with their escapades came to an end and in due course Smeaton began his education at Leeds Grammar School, but although his progress there in geometry and arithmetic was very rapid the most valuable part of his education was carried on at home among his tools and his models.

Pump that succeeded too well!

It was during this period that his mechanical ingenuity led him into trouble. It happened that a steam engine was being erected at Garforth for the purpose of pumping water from the coal mines, and as might be expected Smeaton was there day after day, keenly watching the operations. He quickly grasped the principle of the steam engine and the method of erecting it and promptly set to work at home to make a miniature engine of his own, equipped with pumps and other apparatus. Having made the engine the next step obviously was to test its powers and this he did upon one of the fish ponds in front of the house at Austhorpe. There was no doubt whatever about the efficiency of his engine for he succeeded in pumping the pond completely dry, with, of course, disastrous results to the unfortunate fishes!

Skill in Metal Working

By the time Smeaton was 14 he had made himself a lathe on which he turned wood and ivory. Subsequently he learned to work in metals and at the age of 18 he could handle tools quite as well as any regular carpenter or smith.

In his sixteenth year Smeaton left school and commenced work in his father's office, copying documents and commencing the preliminary training for the legal profession. His father had an excellent practice and wished his son to succeed him, but this was not to be. The boy's heart was in his workshop among his tools and models, and although he attended the office punctually and worked steadily, it was plain to his father that he felt no interest or enthusiasm in Law.

Law Abandoned

In 1742 the boy was sent to London with the object of breaking him away from his mechanical pursuits and at the same time giving him the best possible legal education. For a time he attended the Courts regularly, but at length he realised that it was useless to go on and he wrote to his father explaining his feelings and asking to be allowed to follow some mechanical occupation. This letter was a great disappointment to the father, but he was broadminded enough to understand that his son could never achieve success in a profession he hated, and he replied giving his assent to the change.

In order to understand to some extent the feelings of the father regarding his son's proposal it is necessary to remember that at that time there was no such profession as Civil Engineering. Almost all the mechanical work of importance was then executed by millwrights and others at little more than labourers' wages. In the eyes of most people, therefore, Smeaton was doing a wildly foolish thing in giving up the prospects of a highly respectable and lucrative profession and descending to the lower social status and poor pay of a workman.

Training as Instrument Maker

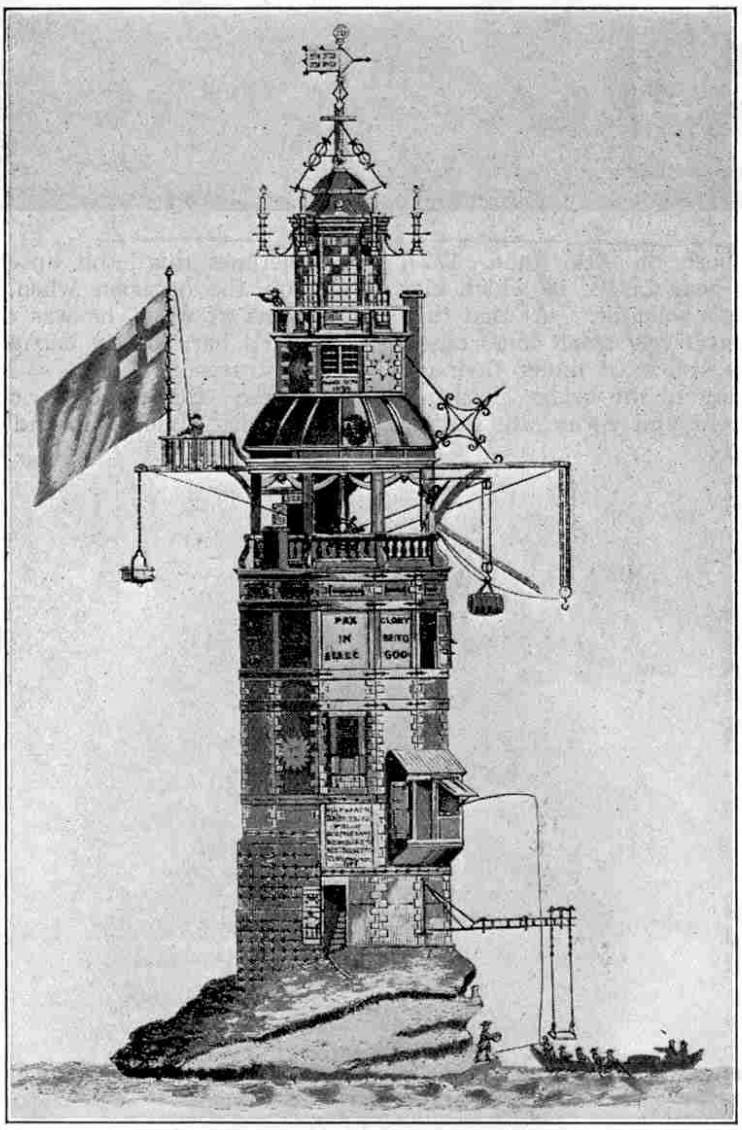
As may be imagined, Smeaton's delight was unbounded when he received his father's consent, and he lost no time in taking advantage of his liberty. He entered the service of a scientific instrument maker in order to obtain expert instruction, his father in the meantime providing for his maintenance. It was not long before Smeaton was able to maintain himself, but his father continued to assist him liberally when occasion demanded.

During this period Smeaton was a regular attendant at the meetings of the Royal Society. In 1750, shortly after he had commenced business on his own account as a mathematical instrument maker, he read a paper before the Society regarding improvements in the mariner's compass. In the following year he carried out experiments on the Thames and at sea to test a machine of his own invention for the purpose of measuring the way of a ship. Subsequently he read before the Society papers on improvements to the air pump and dealing with the steam engine and various other mechanical matters.

Visits Holland and Belgium

Gradually Smeaton began to devote less time to instrument making and to turn to the wider field of engineering. He read diligently all the English books he could find, and not content with this he learned French in order to be able to read the numerous engineering works written in that language. In learning French he had in mind also the possibility of a visit to the Low Countries for the purpose of examining the great canal works that existed there. In 1754 he was able to carry out this project. He traversed Holland and Belgium, examining the canal works and harbour and dock developments, and making detailed notes which afterwards proved of enormous value to him in his work as a canal and harbour engineer.

Soon after his return to England in 1755 an event occurred that provided an opportunity for his constructive genius and led to the greatest success of his engineering career—the building of the Eddystone lighthouse.



First Eddystone Lighthouse.
Completed in 1700, swept away in 1703

The Eddystone Rock

The Eddystone rock forms the crest of a reef of rocks situated in deep water in the English Channel about 14 miles from the Plymouth breakwater and 9 miles from the nearest coast of Cornwall. Some of the rocks are visible at low water but at high water they are almost entirely submerged. As the rocks lie nearly in the track of vessels going up or down the Channel they were the cause of many terrible wrecks before their position was indicated by the erection of a lighthouse. Not only were vessels wrecked upon the rocks themselves, but many a ship's captain, taking a course to the southward in order to give this peril a wide berth, found himself involved in equally serious dangers along the French coast or among the rocks that surround the Channel Islands.

The first attempt to construct a lighthouse upon the small crest of rock visible at high water was made by Henry Winstanley of Littlebury, Essex. Winstanley appears to have been a very curious individual. There is no doubt that he possessed great mechanical ingenuity but there was something fantastic or grotesque about his various productions.

Winstanley's Lighthouse

Smeaton tells us in his "Narrative of the building and a description of the construction of the Eddystone Lighthouse with Stone" that Winstanley's house was a somewhat exciting place for guests. In one room, for instance, there lay on the floor an old slipper. The natural instinct of everybody was, of course, to kick this slipper, and immediately this was done an alarming-looking ghost arose from the floor. In another room was a chair that looked particularly inviting, but immediately anyone sat down in it two arms shot out and held him prisoner. Worst of all was the contrivance in the summer house in the garden, for when anyone sat down on a particular seat he was immediately deposited in the middle of the adjacent canal. It is not surprising that a man who would spend time and money on schemes of this kind should produce a fantastic structure when he turned his attention to lighthouse-building.

Difficulty of Building Operations

Work on Winstanley's lighthouse was commenced in 1696 and it lasted four years. The first summer was spent entirely in boring twelve holes in the rock and fastening in them twelve irons to hold the super-structure. This was a work of considerable difficulty and danger, and operations could be carried on only during fine weather when the sea was comparatively smooth.

In his narrative of the work Winstanley says :—" Though nothing could be attempted to be done but in the summer season, yet the weather then at times would prove so bad that for 10 or 14 days together the sea would be so raging about these rocks, caused by outwinds and the running of the ground seas coming from the main ocean, that although the weather should seem and be most calm in other places, yet here it would mount and fly more than 200 ft. as has been so found since there was lodgement on the place ; and therefore all our works were constantly buried at those times and exposed to the mercy of the seas ; and no power was able to come near to make good or hold anything as I have often experienced with my workmen in a boat in great danger."

Structure Rises to 80 ft.

The second year was spent in making a solid pillar 12 ft. in height and 14 ft. in diameter upon which to set the lighthouse. In the third year all the upper work was erected to the vane, which was 80 ft. above the foundation.

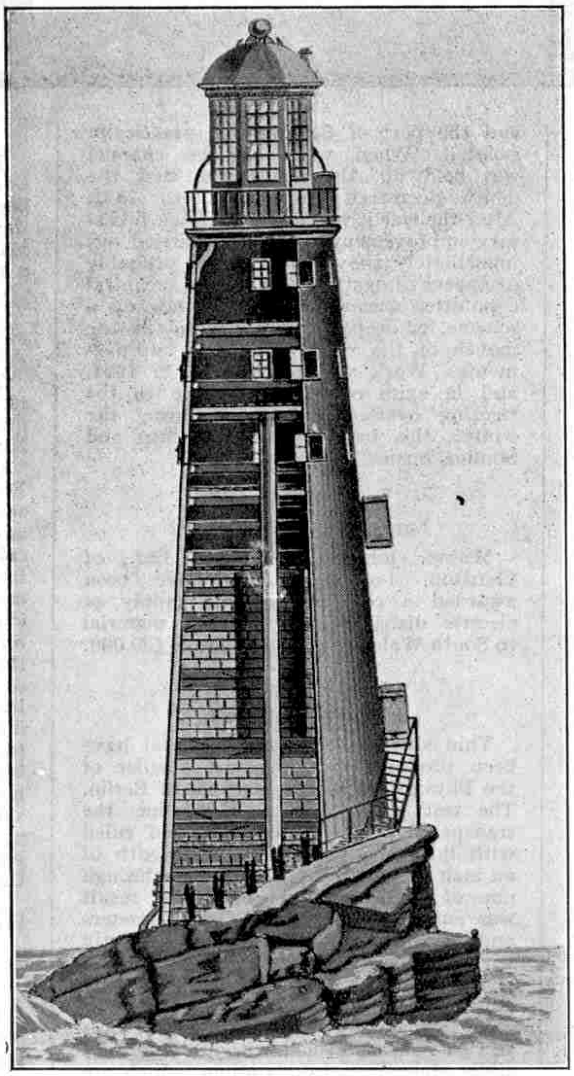
During the summer of that year Winstanley took up his abode with the workmen in the lighthouse. On the same night a great storm arose and eleven days elapsed before any boats could come for them. During this time all in the lighthouse were half-drowned and their provisions were soaked. The light was exhibited for the first time on 14th November 1698 and subsequently the building was strengthened in various ways. Our illustration gives a good idea of the curious appearance of this remarkable structure, Winstanley being shown fishing from the kitchen window !

Swift Disaster

In spite of its weird structure this lighthouse survived until 1703 and then came disaster. In November of that year Winstanley went off to the lighthouse to superintend certain repairs and while he was still there a storm of unparalleled fury occurred on the night of the 26th. At dawn on the following morning many anxious eyes from the shore looked out across the raging seas in the direction of the rock to see if the lighthouse had withstood the gale, but not a vestige of it remained !

Winstanley's lighthouse was a hopeless piece of work from the point of view of stability, but due credit must be given to its builder in having undertaken a piece of work that previously had been considered impossible.

The sweeping away of this lighthouse left the Eddystone problem as serious as before, and it was not long before a new lighthouse builder appeared upon the scene.



Rudyerd's Lighthouse.
Completed in 1709, destroyed by fire in 1755

Rudyerd's Structure

This time the architect was John Rudyerd, who kept a silk shop in London. Rudyerd was the son of a Cornish labourer of bad character and as he declined to join the family schemes for pilfering he found life at home so unpleasant that he ran away. He was befriended by a gentleman at Plymouth, whose servant he became, and who gave him the opportunity of learning the rudiments of reading, writing and arithmetic.

It is not clear how Rudyerd worked his way up to be a successful shop-keeper or how he became qualified for the execution of a formidable engineering task. All we know is that in 1706 the Corporation of Trinity House obtained an Act of Parliament enabling them to rebuild the lighthouse, vesting in them all duties payable by shipping passing the lighthouse, and giving them power to grant a lease to an approved person who should undertake the construction of the building. They agreed with a Captain Lovet for a term of 99 years commencing from the day that a light should be exhibited, and it was Captain Lovet who employed Rudyerd. Apparently there is no record of how Lovet came to discover Rudyerd's engineering knowledge and ability.

Contrast in Design

Winstanley and Rudyerd presented the strongest possible contrast in their mechanical ideas. Whereas the former, as we have seen, was unable to avoid what might be called freak designs, the latter had no thought for anything beyond the essentials of solid strength and suitability for the purpose. To use Smeaton's words : " He saw the errors in the former building and avoided them. Instead of a polygon he chose a circle for the outline of his building and carried up the elevation in that form. . . . He seems to have adopted ideas the very reverse of his predecessor, for all the unwieldy ornaments at the top, the open gallery, the projecting cranes and other contrivances more for ornament and pleasure than use, Mr. Rudyerd laid totally aside."

The means employed by Rudyerd to fix the work to its foundation proved thoroughly efficient. Holes were cut in the solid rock in which strong bolts were keyed, any spaces being afterwards filled with molten pewter. To these bolts were fixed squared oak baulks and across these shorter baulks, and so on until a solid basement of wood was raised, firmly bound together with screw bolts. In order to further strengthen his basement and counteract the tendency of the waves to move it he interposed courses or layers of Cornish stone thoroughly joined and cramped with iron. Outside the solid timber and stone courses strong upright timbers were fixed and carried upward as work proceeded. The light was exhibited in the lantern on 28th July 1706 and the structure was completely finished in 1709.

Destruction by Fire

This lighthouse was in most respects well adapted for its purpose as is proved by the fact that it withstood all storms for nearly 50 years. Its fatal defect was that, like Winstanley's structure, it was built of wood. About two o'clock in the morning of 2nd September, 1755, the light keeper on duty, on going up into the lantern, found it full of smoke.

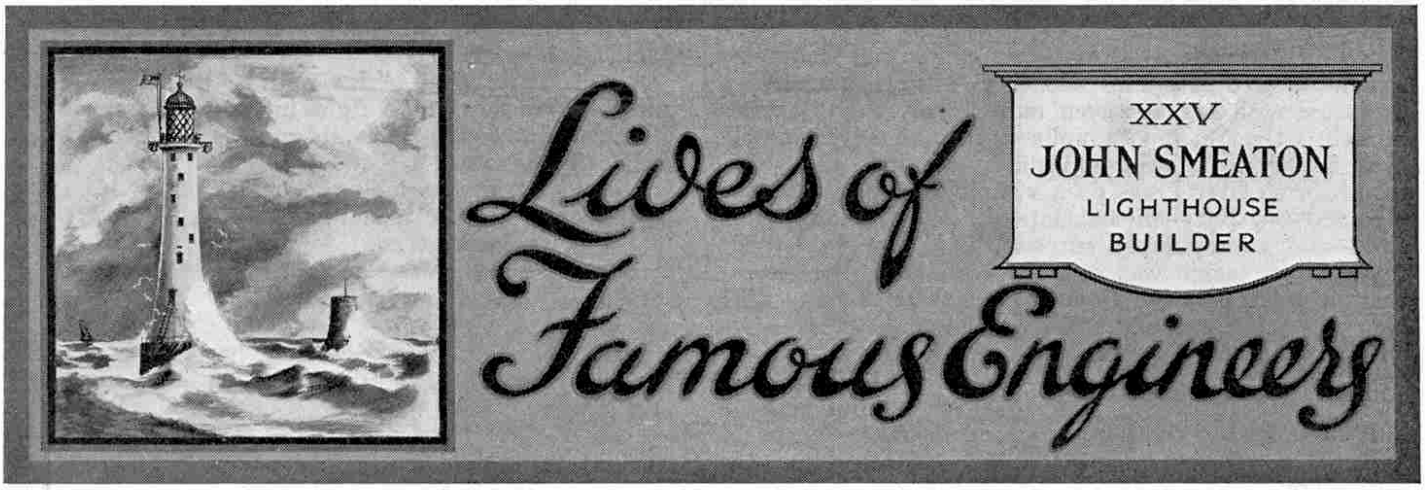
In a few minutes the wooden structure was ablaze. The men could not bring water up the tower in sufficient quantities to have any effect, molten lead began to shower down and they were driven from room to room, the fire following them. Ultimately the men took shelter from the molten lead and falling timbers under a ledge of the rock on its eastern side, and after the fire had been burning some eight hours they were rescued, more dead than alive, by fishing boats.

Smeaton appointed Architect

The lease of the lighthouse had by this time passed into the possession of Robert Weston and two others, and after the destruction of Rudyerd's building Weston applied to the Earl of Macclesfield, President of the Royal Society, for advice as to the choice of an architect to undertake the new building. Lord Macclesfield recommended Smeaton, and Weston immediately approached him on the subject.

At first Smeaton was under the impression that the lighthouse had not been totally destroyed and that all that was required of him was the repair of its upper works, and he declined the proposal. When it was made clear to him that an entirely new structure must be erected, he took the matter in hand and brought the full weight of his ability to bear upon the problem of designing a building that should be storm-proof and fire-proof. The subject was quite new to him but he lost no time in investigating it thoroughly, and one of the earliest conclusions at which he arrived was that the new building must be constructed of stone.

Next month we shall describe how Smeaton planned and erected a wonderful lighthouse that stood without flinching for over 100 years.



LAST month we saw how the Eddystone lighthouses of Winstanley and Rudyerd came to disaster, the former by the power of the sea and the latter by fire, and how Smeaton had the task of erecting a third lighthouse.

Even with the knowledge of the fate of the first two lighthouses there still prevailed at this time a popular impression that nothing but wood could possibly stand on the Eddystone rock. Smeaton, on the other hand, realised that stone was the only possible material for such a structure. He arrived at this conclusion to a large extent as the result of a careful study of the previous structures with the object of discovering their defects. He soon became convinced that both structures were deficient in weight and that even if Rudyerd's lighthouse had not been destroyed by fire, it probably would have shared the fate of its predecessor and been washed away in a heavy storm. Smeaton's conclusion was that the lighthouse must be so contrived as not to give way to the sea and therefore that it must be so strong that the sea would be compelled to give way to it.

Smeaton Visits the Rock

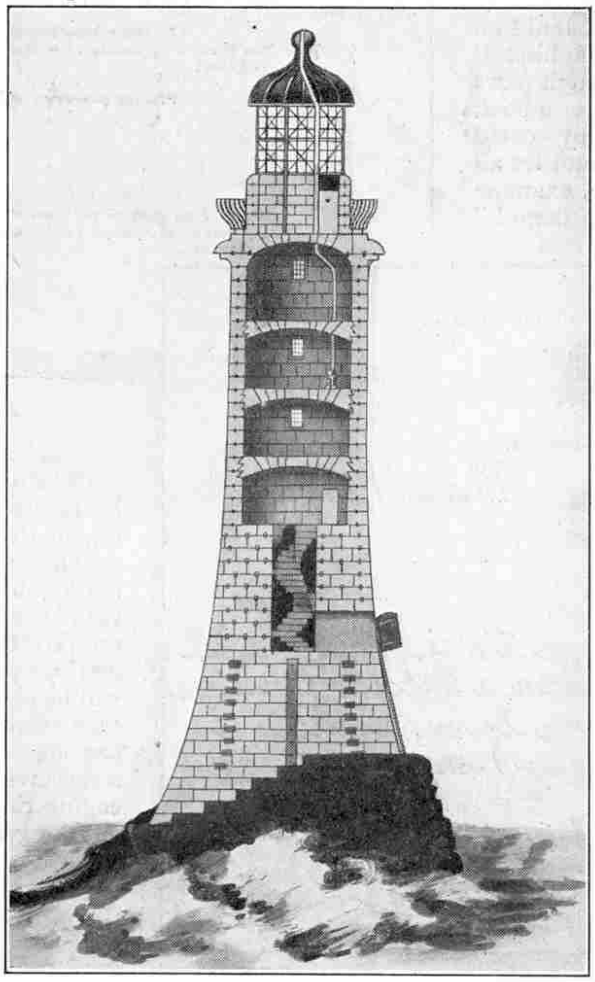
Having decided upon stone, Smeaton's next problem was how the blocks were to be fastened together in order to obtain the greatest possible strength. At first he considered the possibility of binding the blocks together by iron cramps but this method he soon dismissed as not only inadequate but also impracticable. Gradually he thought out a scheme of dovetailing on the lines adopted in carpentry. He considered that by this means the blocks might be made mutually to lock one another together, thus securing unassailable strength.

Having considered these important preliminaries Smeaton's next task was to visit the rock itself, and for this purpose he set out from London to Plymouth. As indicating the terrible state of the roads at that time it is interesting to note that this journey occupied no less than six days! On arrival at Plymouth Smeaton was introduced to a foreman shipwright named Josias Jessop, who gave him valuable information regarding the previous lighthouse and rendered great assistance throughout the progress of the new work.

Delays through Bad Weather

Very naturally Smeaton was anxious to visit the Eddystone rock at once, but he was delayed a few days owing to bad weather. Finally, on 2nd April, 1756, the weather had improved sufficiently to permit of a voyage to the rock, but on arrival there it was found that the waves were breaking over the landing place with such violence as to make landing impossible. A second trip was made three days later and on this occasion Smeaton was able to land upon the rock and stay there for two hours. The only traces he found of the previous lighthouses were the iron branches fixed by Rudyerd and traces of those fixed by Winstanley. After this, with various interruptions due to bad weather, Smeaton continued to visit the rock regularly and gradually completed his design for the structure.

His next step was to return to London and make his report to the proprietors. In order to make his scheme perfectly clear he set to work to construct a complete model of the lighthouse and this occupied over two months. The time spent upon this model was well repaid, however, as after examining it the proprietors, and later the Lords of the Admiralty, fully approved of the design.



Section of Smeaton's Lighthouse

Smeaton then returned to Plymouth to commence the necessary arrangements for constructing the foundations of the lighthouse, breaking his journey at Dorchester to order a supply of Portland stone of which he had decided that the lighthouse should be mainly built. On his arrival at Plymouth workmen were engaged and workyards hired, and vessels were provided for the transport of men and materials between the shore and the Eddystone Rock. Josias Jessop, of whom Smeaton by this time had formed a high opinion, was appointed resident engineer of the building.

Work on the Rock Begun

On 3rd August, 1756, Smeaton visited the rock and fixed the centre and laid down the lines. Work then commenced and as far as weather conditions would allow proceeded regularly. In the most favourable circumstances it was impossible for work to be carried on for more than six hours continuously, and in order to make the utmost of any spells of fine weather the men worked by torchlight.

Smeaton's main object during this first year was to complete the cutting out of the rock of all the recesses to receive the foundation stones. He soon found that the amount of time wasted in voyages between the rock and the shore was very serious and therefore he arranged for a vessel called the "Neptune" to be anchored at a convenient distance from the rock and utilised as a floating store house. As the season progressed the weather conditions

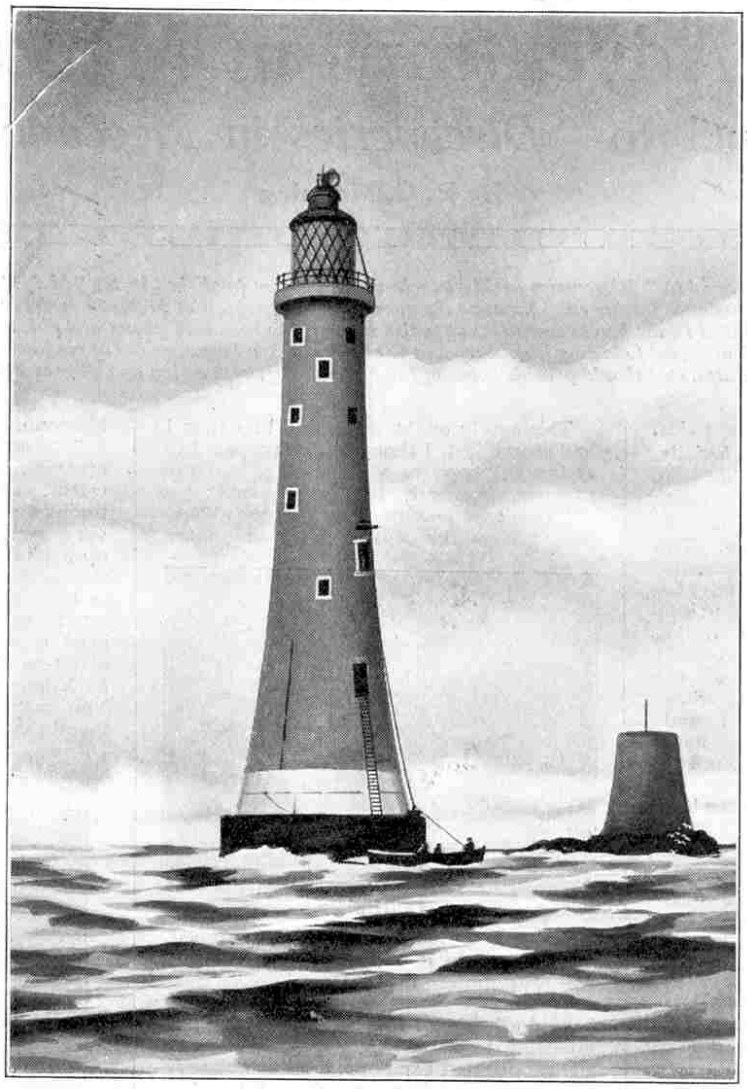
became worse and for many days together work was out of the question. Landing at such times was almost impossible and even if the men could have reached the rock they would have been washed off immediately. Every possible opportunity of work was seized, however, and frequently the men were landed on the rock for spells as short as two hours. By the end of November the necessary cutting of the rock was completed and the working party prepared to return to the mainland to proceed with the dressing of the stones for use in the following year.

A Thrilling Experience

The homeward voyage of the "Neptune" provided Smeaton with a thrilling experience of which he wrote a graphic account. A fierce gale was blowing and as the "Neptune" found it impossible to make Plymouth Harbour she was steered for Fowey. During the night the gale steadily increased and at one period Smeaton heard a sudden clamour on deck, and ran up to see what was happening. It was raining hard and something like a hurricane was raging.

"It being very dark," says Smeaton, "the first thing I saw was the horrible appearance of breakers almost surrounding us; John Bowden, one of the seamen, crying out 'For God's sake heave hard at that rope if you mean to save your lives.' I immediately laid hold of the rope at which he himself was heaving as well as the other seamen, though he was also managing the helm. I not only hauled with all my strength, but called to and encouraged the workmen to do the same thing. In as little time as I have been describing our situation the vessel's head was brought round so that we no longer faced the breakers which, from the darkness of the night, were almost the only objects we could see. The vessel was then heaved down by the stress of the wind, her gunnel to the water, but as we soon found she answered her helm, we concluded she was making way. It would require a pen of a different sort from mine to describe the jeopardy of our present situation, while we were uncertain whether or not we should escape the rocks on which the seas were breaking with a tremendous noise."

No vestige of land could be seen and as the sailors were very uncertain as to their position on the coast they put out to sea again, facing huge waves which occasionally broke completely over the ship. At daybreak they found themselves driving towards the Bay of Biscay. Wearing ship, they once more steered for the Cornish coast and before night had sighted the Land's End. Another miserable night and day passed and finally, after a terrible tossing for four days, they came to anchor in Plymouth Sound to the great relief of those on shore, who had begun to fear that the "Neptune" had gone down.

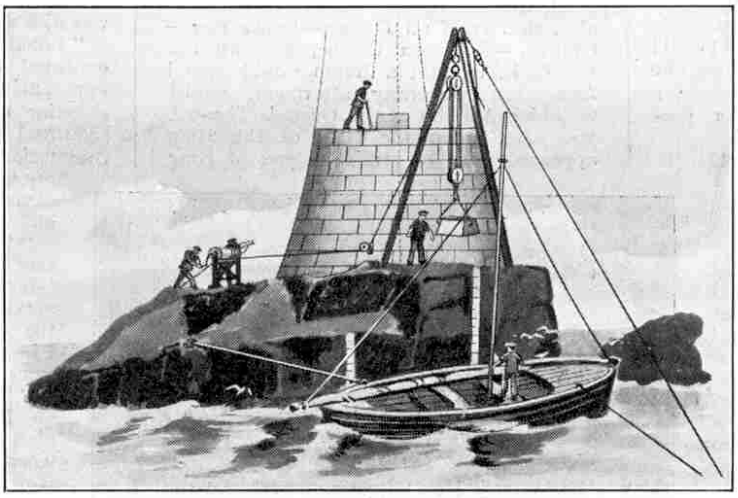


Present Eddystone Lighthouse and Stump of Smeaton's Tower

Preparing the Stones

The following winter was occupied in preparing the stones for the next summer's building operations. Smeaton himself laid out all the lines on the workroom floor in order to secure the greatest accuracy in fitting. He had considerable difficulty in finding a floor large enough for this purpose, and apparently the authorities of Plymouth were not too well disposed towards him as his request for the use of a suitable room in the Guild Hall was refused by the Mayor on the pretence that the chalk marks would spoil the floor! He was also refused the use of the Assembly Rooms for some similar reason, and at length had to obtain the necessary floor space by taking down a partition in the coopers' workshops. By the time weather conditions permitted building operations to be commenced, nearly 450 tons of stone were dressed and ready.

As early as possible in the summer of 1757 building on the rock was commenced and by the 12th June the first stone, weighing 2¼ tons, had been landed and securely fixed in its place. By the evening of the next day the first course of four stones was laid and the second course was completed by the end of the month. There were many interruptions during the earlier operations due to wild weather and heavy seas, but when the sixth course had been laid it was found that the building rose above the average wash of the sea and from that time progress was more regular and rapid.



Work advanced to 15th course, showing method of landing and hoisting the stones

Simple Method of Work

The method of work adopted was very simple but at the same time very effective. When the stones of which a course was to consist were dressed, they were brought together upon a platform in the yard and fitted into exactly the position they would occupy in the building. Each stone was then marked and numbered so that it could be restored to its proper position without difficulty. Each course of stones was then taken out in a vessel, landed and fixed in place without any confusion occurring.

Smeaton spared no pains to make his structure as solid as possible. Not only

(*Continued on page* 127)

Results

Christmas Present Contest

The flood of entries for this contest once more proved our readers' enthusiasm and resulted in the selection of the following articles as the most popular, the order given being decided by the voting :—The Hornby Electric Train ; The Hornby No. 2 Pullman Train ; Meccano Outfit No. 7 ; Miss America Launch ; Structo Auto Builder No. 12 · Gambrell Baby Two Wireless Set.

The prize was awarded to D. MacDougall (Kinlochleven, Argyllshire), whose list gave the chosen six in the correct order of voting.

Most Difficult Puzzle

The voting in this contest placed the various puzzles in the December "*M.M.*" in the following descending order of difficulty :—161, 150, 160, 152, 158, 153, 159, 157, 154, 155, 156 and 151. No completely accurate list was received and the prizes of £1 1s. 0d., 10/6 and 5/- were awarded respectively as follows :—A. C. Grimeberg (Muswell Hill, N.1) ; K. Brookes (Leek, Staffs.) ; J. L. A. Rogers (Oldham).

21st Photo Contest

The awards were as follows :—

Section "A"—First Prize, F. G. Clements (Luton). Second Prize, A Carrier (Northampton). Section "B"—First Prize, R. Stimson, Jnr. (Lowestoft). Second Prize, A. Ives (Crosland Moor, Huddersfield).

Cover Voting Competition

The voting in this contest was extremely heavy and the result is interesting. The final order of popularity of the covers was as follows :—December, September, April, June, May, October, January, November, March, February, July and August. Detailed comment on the results of this contest will be made when the Overseas results are available.

No competitor succeeded in giving a completely accurate list and prizes of Meccano Goods to the value of £1 1s. 0d., 15/-, 10/6 and 5/- respectively, were awarded to the following competitors whose forecasts were most nearly correct :—G. N. O'Neill (Donnybrook, Dublin) ; H. Beats (Dundee) ; R. H. Hill (Sheffield) ; L. A. Duck (Elsted, Midhurst).

Copies of the new Manual, "Meccano Standard Mechanisms," have been awarded to A. Kimmings (East Acton, W.3) ; W. O. Little (New Southgate, N.11) · R. Russell (Scarborough) ; P. Steward (Kings Lynn).

Christmas Essay Contest

Awards :—

Section "A"—First Prize, J. Moore (Carlisle). Second Prize, P. A. Dunston (Streatham, S.W.16). Section "B"—First Prize, T. W. Piper (Scunthorpe). Second Prize, F. W. Skinner (Lanark).

December Puzzles

The awards (Meccano or Hornby Train goods, value £1 1s. 0d., 10/6 and 5/- respectively) were as follows :—K. F. Whyman (Stockton Heath, Ches.) ; J. Yates (Mossley, Manchester) ; E. J. Dickie (Muswell Hill, N.10).

Christmas Painting Contest

The majority of the entries showed that our artist readers had a very vivid conception of the requirements of their task and many strikingly original designs were submitted.

The awards were as follows :—Section "A"—First Prize, W. J. Glenn (Ipswich). Second Prize, R. F. Young (Wembley). Section "B"—First Prize, A. Hebdin (Ringmer). Second Prize, A. Chadwick (Macclesfield).

Overseas Results

6th Drawing Competition

The Overseas Section of this competition, the subject of which was "A Great Passenger Liner," once again showed that our Home readers cannot give our Overseas readers any points for enthusiasm and artistic skill. There was a very large number of entries and steamships of every maritime nation were represented. The standard of the best entries was so high that the judging required very close attention to details.

As was the case in the Home Section, the "*Majestic*" was the most popular ship, and it was pleasing to observe the many entries from boys living in out-of-the-way inland towns who used illustrations of this ship to aid their imaginations. Many of those boys had never seen an actual liner.

Awards :—

Section A—First Prize, R. A. Evans (Linwood, Christchurch, N.Z.) Second Prize, J. de Conti Manduca (Sliema, Malta). Section B—First Prize, N. Greenslade (Wellington, N.Z. Second Prize, G. Moraldi (Rome 8)

16th Photo Contest

This competition, the subject of which was "A June Landscape," proved extremely popular and entries were received from all parts of the world. The scenes illustrated, as was to be expected, were widely different in type, and especially was it strange to find prints showing parched deserts side by side with snow-laden plains in one competition !

Our photographic readers should note that the title of a competition subject is not necessarily to be the title of their own entry for that particular contest. Any title may be used, provided that the general rules of the contest are carried out.

The judging of this competition was not so difficult as usual, the winning entries being easily the best, and the awards are as follows :—

Class A.—First Prize, F. Van Bulch (Paris XI.) ; Second Prize, Prince Evans (Hakitika, New Zealand). Class B—First Prize, D. B. Marsh (Nashwaaksis, York County, New Brunswick) ; Second Prize, J. Fletcher (Dunedin, New Zealand)

Eighth Drawing Contest

The entries for this contest were more numerous than usual and there was little to choose between the ultimate prizewinners. Ships of all ages, ranging from slave-galleys to aeroplane carriers, were represented. The prizewinners were as follows :—

Section "A"—First Prize, J. de Conti Manduca (Sliema, Malta). Second Prize, C. Cameron (Christchurch, N.Z.)

Section "B"—First Prize, P. Renault (Alencon, Orne, France). Second Prize, J. Knox (Hawkesbury, Ont., Canada).

Eighteenth Photo Contest

The following are the awards :—

Section "A"—First Prize, T. K. Leng (Singapore). Second Prize, E. Smith (Toronto, Canada). Section "B"—First Prize, L. Stevenson (Napier Barracks, Karachi). Second Prize, H. Harris (Ficksburg, O.F.S.)

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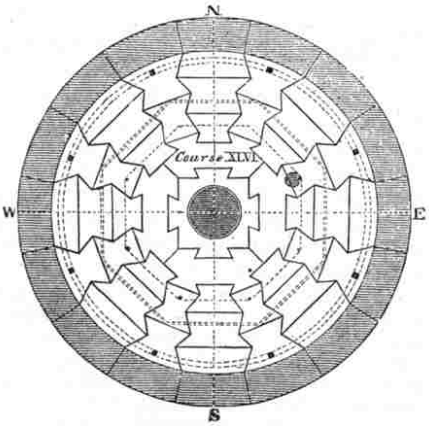
were the blocks dovetailed so as to lock one into the other, but also they were joined by trenails, or pegs of oak, which were driven into holes bored in the stones. The fixing was so secure that Smeaton stated that a trenail would pull in two sooner than pull out of the hole into which it was fitted. Additional firmness was given to the stones dovetailed into the rock by means of oak wedges and cement inserted between each. By the end of the season the ninth course of stones had been completed without any accident



Plan of the 46th course, showing method of dovetailing

more serious than the occasional washing away of stones or tools which were easily replaced.

The Last Stages

After a particularly wild winter Smeaton landed again on the rock on 12th May, 1758, and was delighted to find the work exactly as he had left it six months previously. In spite of the raging seas not a block had been moved. Work proceeded with few interruptions until late in September, by which time the twenty-fourth course was finished, the building now

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having been raised a little over 35 ft. above its base. This completed the solid part of the structure and formed the floor of the store room. Above this point the apartments for the lighthouse keepers were built with walls 26 in. thick. By the end of this year's work the twenty-ninth course was completed and a sort of temporary house was constructed over the work to protect it during the winter.

The following season was abnormally rough and it was not until 5th July that the workmen could land upon the rock and continue their building operations. The structure was now well beyond the heavy stroke of the waves and operations continued so rapidly that by 17th August the forty-six courses of stones were completely finished and the lighthouse had reached its specified height of 70 ft. The final mason's work done was the cutting of the words "Laus Deo" (Praise to God) upon the last stone set over the door of the lantern.

Light Exhibited for First Time

Smeaton's work was now almost complete and his anxiety had become so great that he lived entirely in the lighthouse and personally assisted his workmen in the finishing of the last details. The light was first exhibited on the night of 16th October, 1759, and the engineer was able to leave the rock knowing that his work was well and truly accomplished.

Smeaton's lighthouse stood for over 100 years, and probably might still have been standing but for the fact that the reef itself had become undermined and weakened by the sea. Various efforts were made to save the lighthouse, but without success, and in 1877 Sir Charles Douglass, Engineer-in-Chief to Trinity House, announced that Smeaton's structure was to be taken down. In the following year the first stone of the present lighthouse, built to the design of Sir James Douglass, was laid upon the rock at a distance of about 100 ft. from Smeaton's tower. The new lighthouse was completed in 1881. Smeaton's lighthouse had then reached the end of its long and useful career and it was removed, with the exception of its stump, to Plymouth Hoe. The stump of the tower still remains—a lasting monument to the genius of the man who, in this one structure, brought the lighthouse so close to perfection that subsequent designers have found little to alter except in detail.

NEXT MONTH :—

Smeaton as Harbour Engineer

The Future of the Young Engineer—

(*Continued from page* 131)

"The heights by great men reached and kept
Were not attained by sudden flight,
But they, while their companions slept
Were toiling upward in the night."

Believe me, developments in Engineering science and practice were never so numerous as to-day ; the horizon for young Engineers was never wider, the possibilities of success never greater.

I pray you therefore to approach your work with a proper pride in this great profession you have embraced, with quiet confidence in the future it holds for you, and with a determination that your motto shall be that of Benjamin Franklin—"Plough deep while sluggards sleep."