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LIGHTHOUSES AND LIGHTSHIPS

A Descriptive and Historical Account of Their Mode of Construction

by

William Henry Davenport Adams

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Published by Forgotten Books 2013

Originally published 1871

PIBN 1000747285

www.ForgottenBooks.org

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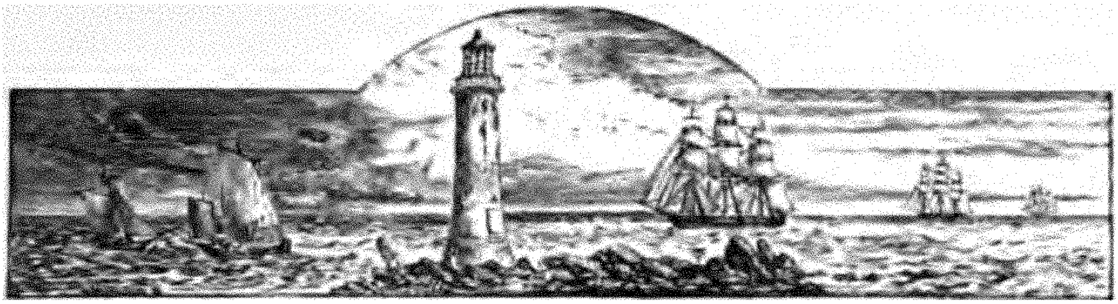


LIGHTHOUSES

AND

LIGHTSHIPS:

A DESCRIPTIVE AND HISTORICAL ACCOUNT OF THEIR MODE OF CONSTRUCTION AND ORGANIZATION.

BY

W. H. DAVENPORT ADAMS,

AUTHOR OF "BURIED CITIES OF CAMPANIA," "QUEEN OF THE ADRIATIC," "EARTH AND SEA," ETC.

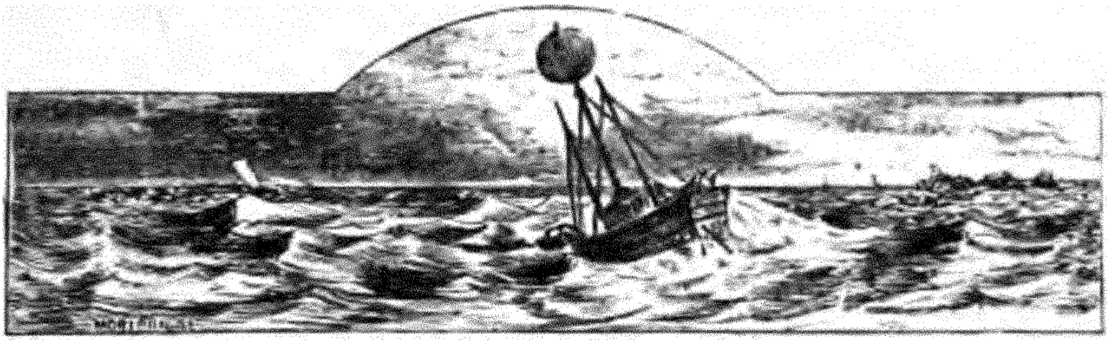
With Illustrations from Photographs and other sources.

LONDON:

T. NELSON AND SONS, PATERNOSTER ROW;

1872, Dec. 20.

Minot Fund.



Preface.

—o—

THE importance of the Lighthouse system which protects our seamen against the numerous dangers and difficulties of the British shores is fully appreciated by every Englishman. But it may reasonably be doubted whether the general public have any correct idea of its completeness, of the administrative principles which regulate its management, or of the steps by which it has attained its present development. They know but little, moreover, of the engineering skill which has been so successfully exercised in the construction of Lighthouses, or of the scientific knowledge which has been brought to bear upon the perfection of their illuminating apparatus. It may safely be said, that for a large number of readers, the alpha of their information, on this subject, is the Eddystone, and their omega the Bell Rock.

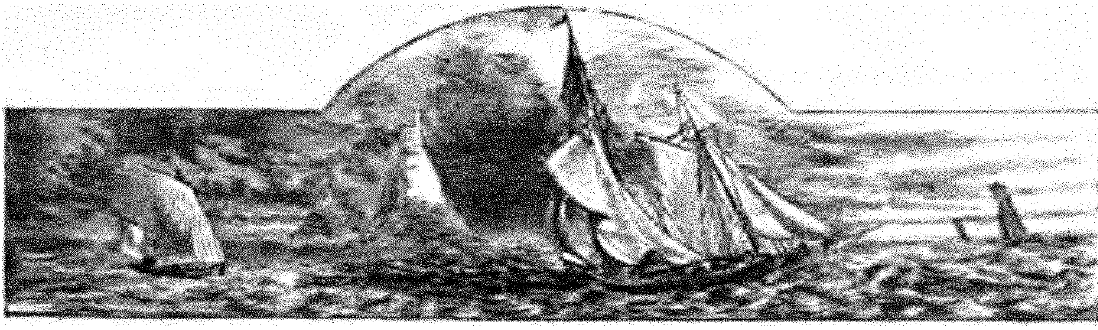
If such be the case, it may be presumed that the present volume will be accepted as an honest attempt to supply an admitted deficiency. It is based on the best authorities, and its pages have been revised by competent critics. Its aim is to furnish in a popular and intelligible form a description of the Lighthouse *as it is* and *as it was*—of the rude Roman pharos or old sea-tower, with its flickering fire of wood or coal, and the modern pharos, shapely and yet substantial, with its powerful illuminating apparatus of lamp and lenses, shining ten, or twelve, or twenty miles across the waves. The gradual improvement of this apparatus is concisely indicated. Sketches are furnished of the most remarkable Lighthouses in Great Britain and France, and a detailed account is given of the mode of life of their keepers, with full particulars of the administrative systems adopted at home and abroad. As auxiliaries in the noble work of guarding the seaman against the perils of rock and shoal, the Lightship, the Buoy, and the Beacon, have also found a place in our pages; and the volume closes with a list of all the Lights existing on the coasts of England, Scotland, and Ireland at the present time.

In my description of the *French* Lighthouses I have been much indebted to M. Renard's book, "Les Phares." The information given respecting *British* Lighthouses has been drawn from a variety of sources, the more important of which are duly acknowledged. I have also derived many particulars from personal examination; and some interesting data and corrections have been supplied by Mr. Thomas Stevenson, the Engineer to the Board of Northern Lights, and the worthy member of a family long associated with lighthouse engineering.

The Illustrations are from photographs, unpublished sketches, and other authentic originals. Those of the French Lighthouses are copied, by permission, from M. Renard.

W. H. DAVENPORT ADAMS.

May 1870.



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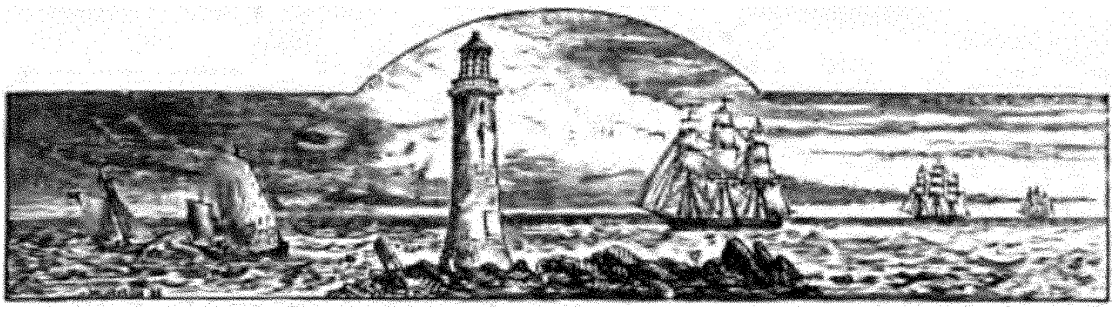


LIGHTHOUSES

AND

LIGHTSHIPS.

BOOK I.

ANCIENT HISTORY OF LIGHTHOUSES.

CHAPTER I.

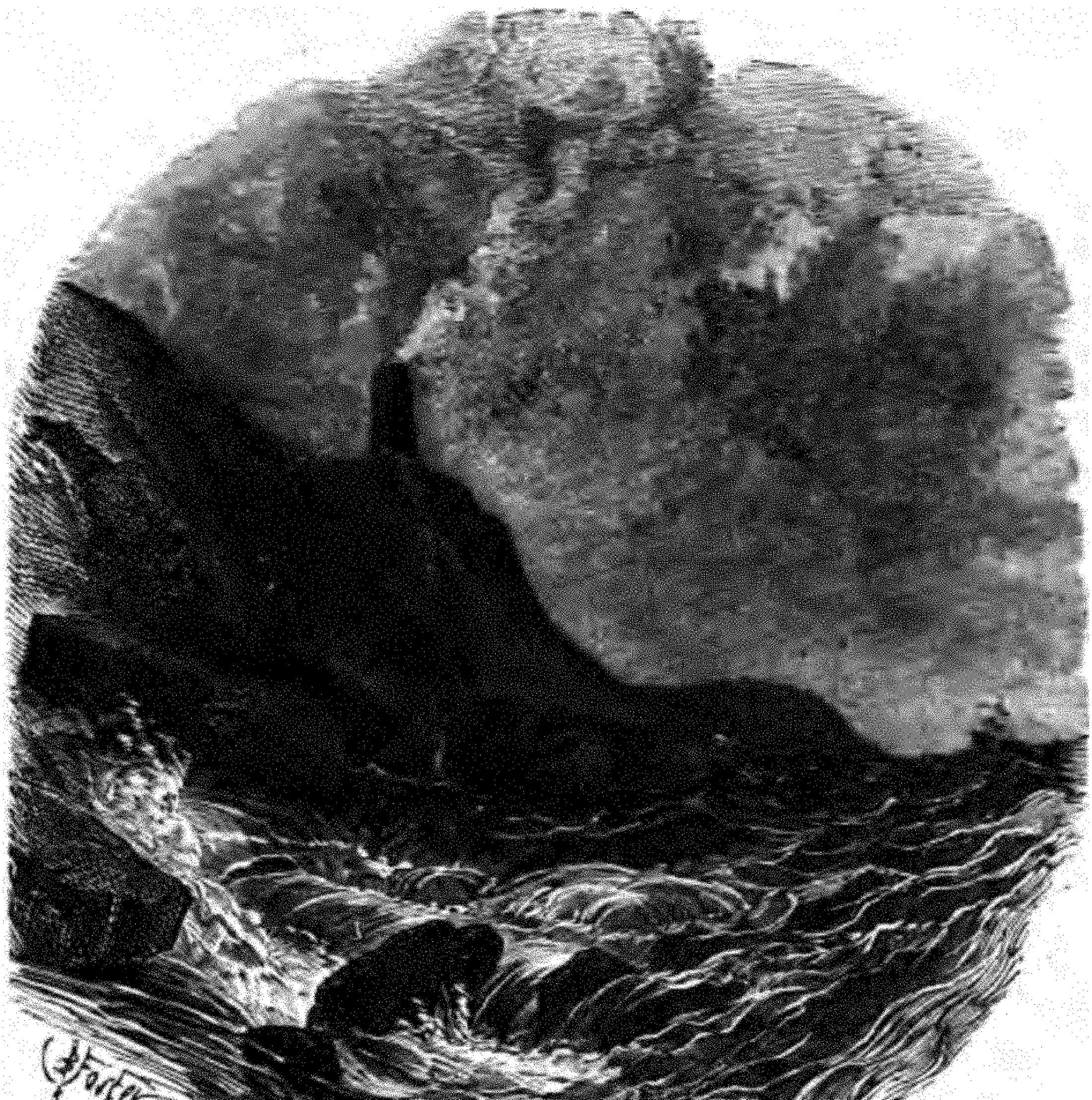
THE FIRE-TOWERS OF THE MEDITERRANEAN.

WE are apt to look upon the lighthouse as completely a modern invention, but a little reflection would convince us that the early navigators, in their arduous struggle against the ocean, could not have failed to establish some sure indications by which to guide their adventurous course. Undoubtedly, the first rude signal would be no more than a huge fire blazing on the wave-washed promontory, or on the summit of hoary hill or grassy mound nearest to the more dangerous parts of the shore. But it can easily be conceived that the difficulty of keeping these fires kindled on stormy nights would soon suggest to man's ingenuity the idea of erecting a suitable structure for their shelter.

The value of this kind of coast defences was so apparent, that the ancients felt unable to ascribe them to simple human invention. And thus the Greeks attributed their origin to the demigod Hercules. But there seems some reason to believe that, long before Greece became a maritime nation, light-towers had been built by the Lybians and the Cuthites along the coast-line of Lower Egypt. These towers, we are told,* served as landmarks during the day, as beacons during the night. Their purpose was a holy one, and accordingly they were also used as temples, and each was dedicated to a divinity. The mariner, who naturally held them in great veneration, enriched them with his votive offerings. It has been conjectured by some authorities that their walls at first were painted with charts of the Mediterranean coast and of the navigation of the Nile; these charts being afterwards transferred to papyrus. The priests of these singular but valuable institutions taught the sciences of hydrography and pilotage, and the art of steering a vessel's course by the aid of the constellations. On the summit of each tower a fire was continually burning; the fire being placed in a machine of iron or bronze, composed of three or four branches, each representing a dolphin or some other marine animal, and all bound together by skilful decorative work. The machine was attached to the extremity of a stout pole, and so placed that its radiance was directed seaward.

According to the Baron de Zach, in his "Correspon-

* Renard, "Les Phares" (Paris, 1867).



THE BEACON FIRE.

dance Astronomique," the Lybian appellation for these towers was *tar*, or *tor* * As *is* signifies "fire," we thus obtain the compound *Tor-is*, or "fire-tower;" whence the Greeks derived their *τυρρîς*, and the Latins their *turris*. In like manner, the Latin *columna* comes, it is said, from *Col-On*, the "pillar of the sun."

Some authorities boldly carry this etymological diver-

* *Tor* is Celtic for a height, as in the *tors*, or granite hills, of Dartmoor.

sion a little further. When the fire-towers were situated upon eminences outside the boundaries of cities, and constructed of a circular form, they were called *Tith.* The mythological Tithonus, so celebrated for his longevity, seems, they assert, to have been one of these edifices dedicated to the sun; and Thetis, the ancient ocean-goddess, simply a fire-tower near the sea, called *Thit-is.* Nor have ingenious theorists been wanting to maintain that the massacre of the Cyclops, who, according to the old legend, were stricken by Apollo's arrows, was nothing but a poetical version of the manner in which the fires of the Cyclopean towers, planted on the eastern coasts of Sicily, were extinguished by the rays of the rising sun.*

The impression which the light-tower produced on the popular imagination is, however, more beautifully, as well as more certainly, described by Homer in a well-known passage of the "Iliad" (bk. xix. 375):—

> "As to seamen o'er the wave is borne
> The watch-fire's light, which, high among the hills,
> Some shepherd kindles in his lonely fold."

In our English Bible the word *beacon* occurs but once —namely in the Prophecies of Isaiah (xxx. 17), who lived about two centuries later than Homer; but in the Septuagint version, the same word is rendered as a "flagstaff" or "perch," and unquestionably refers to a *land*-signal rather than to a maritime light.

The first pharos which performed its duties in a regular manner seems to have been that which Lesches, the author

* As Mr. Stevenson says (in his "Treatise on Lighthouses"), a notion so fanciful as this deserves little consideration.

of the "Little Iliad" (who flourished about the 9th Olympiad), erected on the promontory of Sigeum, at the entrance of the Hellespont. It is figured in the Iliac Table.

Though the most ancient in our records, the honour was not reserved to it of bequeathing its name to its successors, any more than to Columbus the glory of leaving *his* name to the New World. This honour was gained by the mighty tower elevated on the island of Pharos, at Alexandria, which served as a model for some of the most celebrated lighthouses erected in later times. Such was the case with the pharos built by the Emperor Claudian at Ostia, which appears to have been the most remarkable of any on the Latin coast. It was situated upon a breakwater, or artificial island, which occupied the mid space between the two huge moles that formed the harbour;* and its ruins were extant as late as the fifteenth century, when they were visited by Pope Pius II. Not less stately was the pharos which guided the seamen into the port of Puteoli, the emporium of the foreign trade of Imperial Rome; nor that which Augustus erected at the entrance of his new harbour of Ravenna, and which Pliny describes with so much enthusiasm; nor that, again, which shed its warning light from the mole of Messina over the whirlpool of Charybdis and the rock of Scylla; nor that which blazed in the island of Capreæ, and was destroyed by an earthquake shortly before the death of Tiberius.

Dionysius of Byzantium† describes a celebrated light-

* Suetonius, "Claudian," 20.

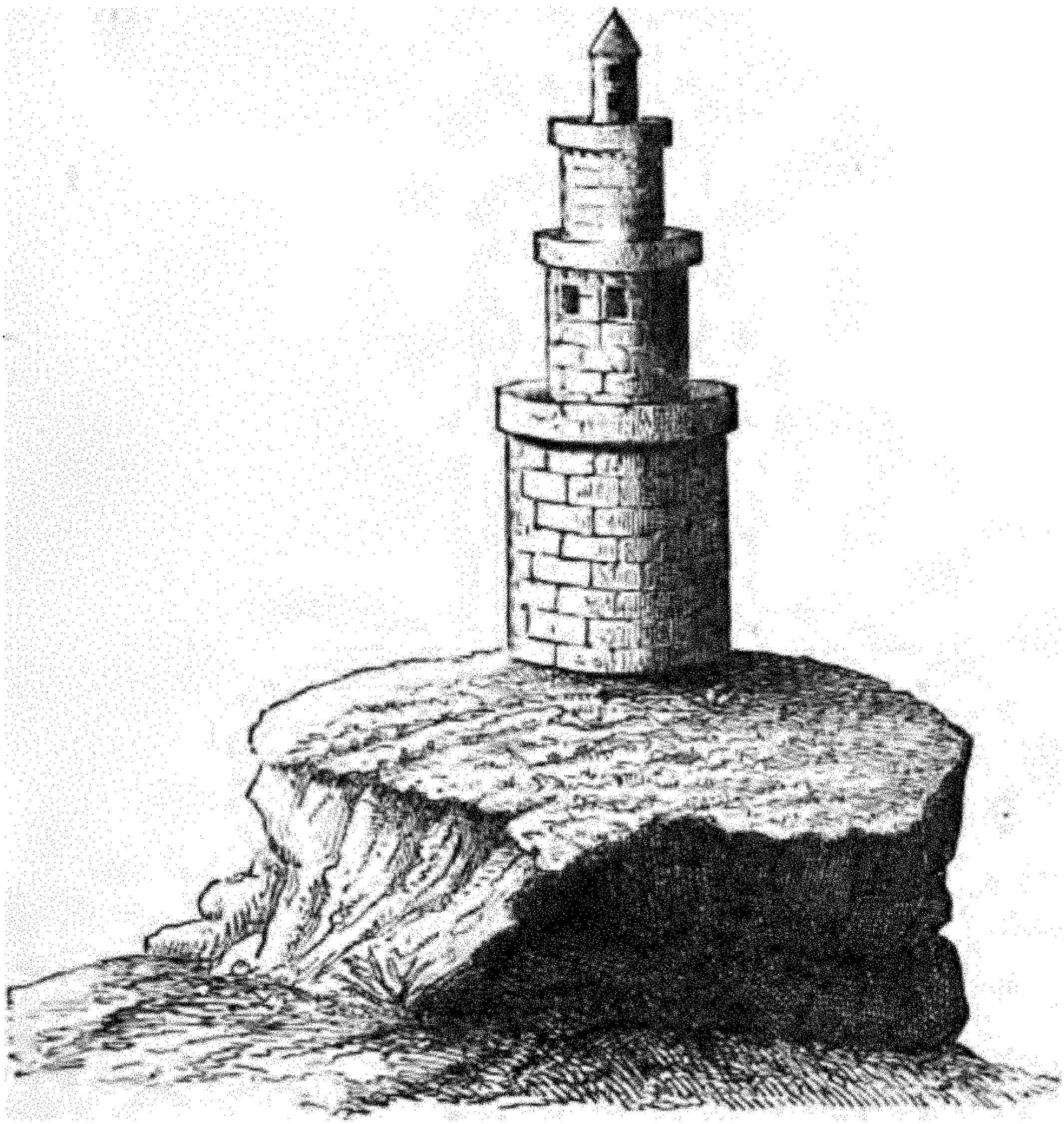
† Author of an Ἀνάπλους Βοσπόρου, *circa* A.D. 190.

house planted at the mouth of the river Chrysorrhoas, where the latter mingles its waters with those of the Thracian Bosphorus (the modern channel of Constantinople). "On the crest of the hill," he says, "whose base is washed by the Chrysorrhoas, may be seen the Timean tower, of an extraordinary height; and from its summit the spectator beholds a vast expanse of sea. It has been built for the safety of the navigator, fires being kindled for their guidance; which was all the more necessary because the shores of this sea are without ports, and no anchor can reach its bottom. But the barbarians of the coast lighted other fires on the loftiest points of the coast, to deceive the mariner, and profit by his shipwreck. At present," adds our author, "the tower is partly ruined, and no lantern is lighted in it."

Strabo refers in exaggerated terms to a superb pharos of stone at Capio, or Apio, near the harbour of Menestheus—the modern Puerto de Santa Maria. It stood on a rocky headland, nearly surrounded by the sea, and served as a guide for vessels through the shallow channels at the mouth of the Guadalquivir.*

What was the form of the Roman light-towers? This is a question not easily answered, when we remember that Herodian compares them to the catafalques of the emperors. The catafalques were square; but it is certain that quadrangular lighthouses were very seldom constructed. Montfaucon reproduces a medallion, from the famous cabinet of the Marechal d'Estrees, which represents a Roman lighthouse as a circular tower, built in four

* Strabo, Edit. Oxon., 1867, p. 184.



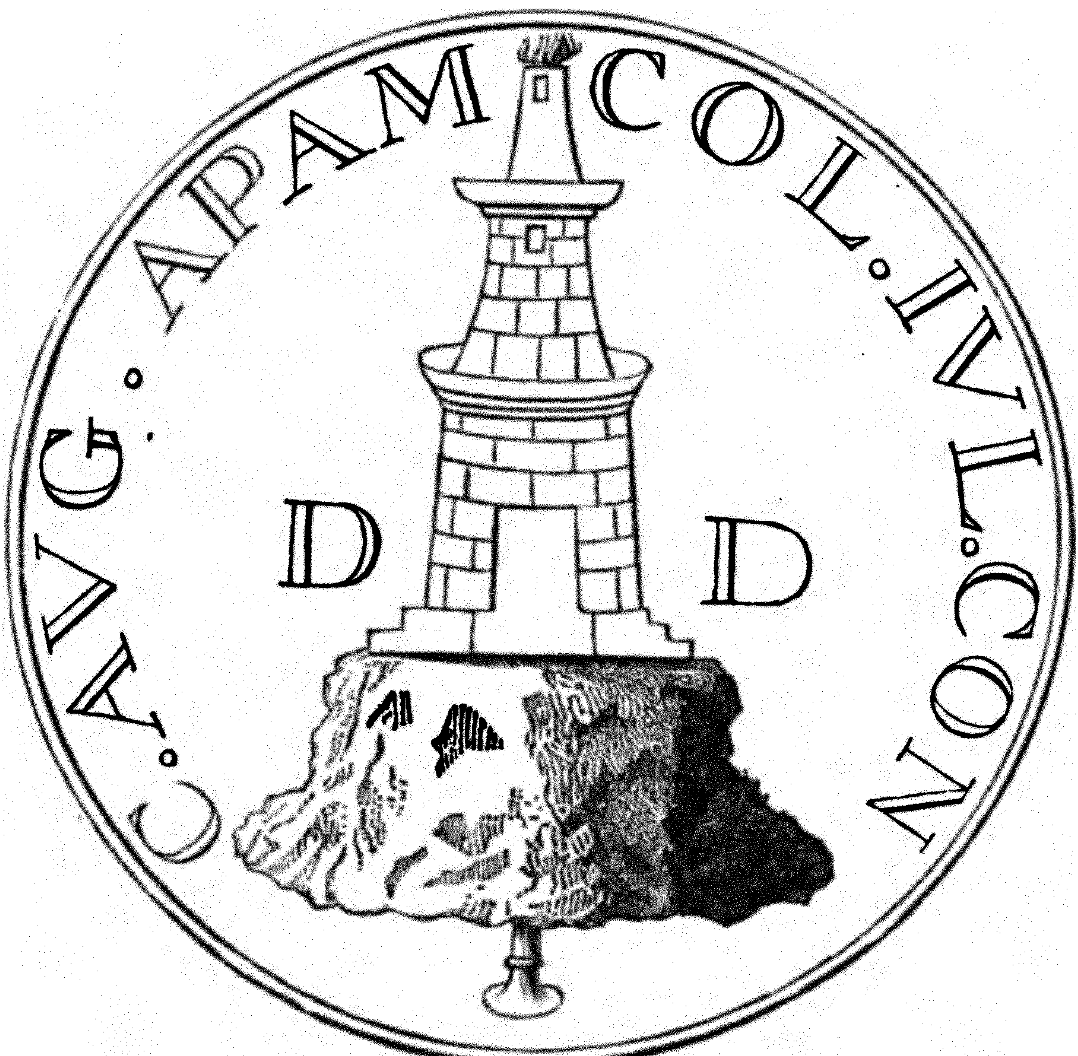
A ROMAN PHAROS (FROM A MEDAL IN THE D'ESTREES' COLLECTION).

stories of decreasing diameter. Another medal, discovered at Apameia, in Bithynia, and also figured by Montfaucon, likewise depicts a circular building. This medal bore the following inscription :—"Colonia Augusta Apameia, Colonia Julia Concordia decreto decurionum."

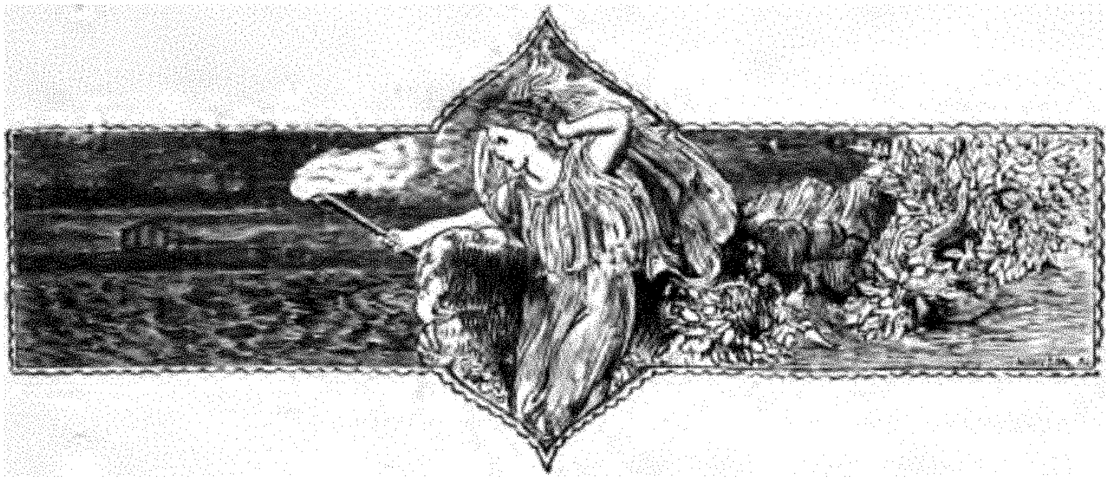
Murleia, in Bithynia, was founded by a colony from Colophon, but having been captured by Philip of Macedonia, he gave it to Prusias, King of Bithynia, who called it after his wife Apameia. It was situated on the south coast of the Gulf of Cius, and to the north-west of Prusa.

The Romans converted it into a *colonia*, apparently about the time of Julius Cæsar; certainly not later than that of Augustus.* And we shall hereafter see that the pharos at Dover, as at Boulogne, was also of this form.

* See Dr. Smith's "Dictionary of Greek and Roman Geography," vol. I., *sub. nom.*



ROMAN PHAROS (AFTER A MEDAL OF APAMEIA).



CHAPTER II.

THE PHAROS OF ALEXANDRIA.

ONE of the most famous lighthouses of antiquity, as I have already pointed out, was the pharos of Alexandria, which ancient writers included among the Seven Wonders of the World. It might naturally be supposed that the founder of so remarkable a monument of architectural skill would be well known; yet while Strabo and Pliny, Eusebius, Suidas, and Lucian ascribe its erection to Ptolemæus Philadelphus, the wisest and most benevolent of the Ptolemean kings of Egypt, by Tzetzes and Ammianus Marcellinus the honour is given to Cleopatra; and other authorities even attribute it to Alexander the Great.

All that can with certainty be affirmed is, that the architect was named Sostrates. Montfaucon, in his great work, endeavours to explain how it is that while we are thus informed as to the *architect*, we are so doubtful as to the *founder*, whom, for his part, he believes to have been Ptolemæus. Our ignorance, he says, is owing to the knavery of Sostrates. He wished to immortalize his name; a blameless wish, if at the same time he had not sought to suppress that of the founder, whose glory it was to have suggested the erection. For this purpose Sostrates devised a stratagem which proved successful; deep in the wall of the tower he cut the following inscription: "Sostrates of Cnidos, son of Dexiphanes, to the gods who Protect those who are upon the Sea." But, mistrustful that King Ptolemæus would scarcely be satisfied with an inscription in which he was wholly ignored, he covered it with a light coat of cement, which he knew would not long endure the action of the atmosphere, and carved thereon the name of Ptolemæus. After a few years the cement and the name of the king disappeared, and revealed the inscription which gave all the glory to Sostrates.

Montfaucon, with genial credulity, adopts this anecdote as authentic, and adds: Pliny pretends that Ptolemæus, out of the modesty and greatness of his soul, desired the architect's name to be engraved upon the tower, and no reference to himself to be made. But this statement is very dubious; it would have passed as incredible in those times, and even to-day would be regarded as an ill-understood act of magnanimity. We have never heard of any prince prohibiting the perpetuation of his name upon magnificent works designed for the public utility, or being content that the architect should usurp the entire honour.

To solve the difficulty, Champollion represents the pharos as constructed by Ptolemæus Soter. But, as Edrisi solemnly remarks, "God alone knows what is the truth."

Much etymological erudition has been expended on the derivation of the word *Pharos*. As far as the Alexandrian light-tower is concerned, there can be no doubt that it was named from the islet on which it stood; yet Isidore asserts that the word came from φῶς, "light," and ὁρᾶν, "to see." To quote again from Môntfaucon: That numerous persons, who have not read the Greek authors, should exercise their ingenuity to no avail in the extraction of these etymologies, is far less surprising than that so good a scholar as Isaac Vossius should seek the origin of *Pharos* in the Greek language. From φαινειν, "to shine," he says, comes φανερος, and from φανερος, φαρος. . . . But the island was called *Pharos* seven or eight hundred years before it possessed either tower or beacon-light.

The most reasonable conjecture seems to be that the word is a Hellenic form of *Phrah*, the Egyptian name of the sun, to whom the Alexandrian lighthouse would naturally be compared by wondering spectators, or dedicated by a devout prince.

At a later date we find the word applied to very different objects, though always retaining the signification of *light* or *brilliancy*. A *pharos* of fire—*i.e.*, a ball or meteor—was seen, says Gregory of Tours, to issue from the church of St. Hilaire, and descend upon King Clovis. The same historian uses the word to describe a conflagration :—"They (the barbarians) set fire to the church of St. Hilaire, kindled a great pharos, and while the church was burning, pillaged the monastery." The old French historian frequently employs the word in this sense, which leads us to suppose that in his time an incendiary was probably designated "a maker of pharoses" (*un faiseur de phares*). Still later, the term *pharos* was applied to certain machines in which a number of lamps or tapers were placed, as in a candelabrum. A modern French writer quotes from Anastasius the Librarian, that Pope Sylvester caused "a pharos of pure gold" to be constructed; and that Pope Adrian I. made one, "in the form of a cross," capable of receiving one hundred and seventy candles or tapers. And Leon of Ostia, in his "Chronicle of Monte Cassino," says, that the Abbot Didier had a pharos, or great silver crown, weighing one hundred pounds, constructed, which was surmounted by twelve little turrets, and from which were suspended six and thirty lamps.

We may add that the poets have employed the word "pharos" in a still more metaphorical sense, to signify an object which instructs while it illuminates, or those remarkable individuals whose genius becomes for all time the light of the world, and a beacon to posterity. Says the French poet Ronsard to Charles IX.:—

> "Soyez mon phare, et gardez d'abymer,
> Ma nef qui nage en si profonde mer."
>
> My guide, my pharos be, and save from wreck
> My boat, which labours in so deep a sea.

But from this digression we return to the Alexandrian Wonder.

The long narrow island of Pharos lay in front of the city of Alexandria, sheltering both its harbours—the Greater Harbour and the Haven of Happy Return (Ευνοστος) —from the fury of the north wind and the occasional high tides of the Mediterranean.

It was a strip of white and dazzling calcareous rock, about a mile from Alexandria, and 150 stadia from the Canobic mouth of the river Nile. Its northern coast was fringed with small islets, which, in the fourth and fifth centuries, became the resort of Christian anchorites. A deep bay on the northern side was called the "Pirates'

Haven," because, in early times, it had been a place of refuge for the Carian and Samian rovers. An artificial mound, or causeway, connected the island with the mainland. From its extent (seven stadia, 4270 English feet, or three-quarters of a mile), it was called the *Heptastadium*. In its whole length two breaks occurred, to permit of the passage of the water, and these breaks were crossed by drawbridges. At the insular end stood a temple to Hephæstus, and at the other the great Gate of the Moon. The famous lighthouse stood on a kind of peninsular rock at the eastern end of the island; and as it was built of white stone, and rose to a great height, it was scarcely a less conspicuous object from the city than from the neighbouring waters.

Some remarkable discrepancies occur in the accounts of this noble edifice, which have been handed down to us, but after all allowance has been made for error and exaggeration, it remains obvious that the wondering admiration bestowed upon it by the ancients was not unjustified. The statements of the distance at which its light could be seen are, however, most undeniably fictitious. That of Josephus, who compares it to the second of Herod's three towers at Jerusalem—called Phasael, in honour of his brother—is the least incredible; yet even he asserts that the fire which burned on its summit was visible thirty-four English miles at sea! Such a range for a lighthouse on the low shores of Egypt would require, says Mr. Alan Stevenson, a tower about 550 feet in height.

Pliny affirms that its erection cost a sum of money equal, at the present value, to about £390,000, and if this were true, we might not dispute some of the assertions of ancient writers in reference to its elevation and solidity. But the fact that it has entirely disappeared seems to disprove the dimensions they have assigned to it. We are wholly unable to decide whether the help it afforded to mariners was from a common fire or from a more complete system of illumination. The poet Lucan, in his "Pharsalia," asserts that it indicated to Julius Cæsar his approach to Egypt on the seventh night after he sailed from Troy; and he makes use of the significant expression "lampada," which could hardly be applied, even poetically, to an *open* fire. Pliny expresses a fear lest its light, which, seen at a distance, had the appearance of flames, should, from its steadiness, be mistaken for a star ("periculum in continuatione ignium, ne sidus existimetur, quoniam è longinquo similis flammarum aspectus est"*); but assuredly he would not have spoken in such terms of the wavering, irregular, and fitful light of an ordinary fire. We conclude, therefore, that its lighting apparatus was more complete than has generally been supposed.

When was this great monument destroyed?

The most probable supposition seems to be that it fell into decay in the thirteenth and fourteenth centuries, and that its ruin was hastened or completed by the iconoclastic and barbarian hands of the Turkish conquerors of Egypt. That it existed in the twelfth century, we know from the graphic description of Edrisi; a description which will enable the reader to reproduce it before his "mind's eye" in all its pristine glory:—

"This pharos," he says, "has not its like in the world for skill of construction or for solidity; since, to say

* Pliny, "Hist. Nat.," xxxvi. 18.

ANCIENT PHAROS OF ALEXANDRIA.

nothing of the fact that it is built of excellent stone of the kind called *kedan*, the layers of these stones are united by molten lead, and the joints are so adherent that the whole is indissoluble, though the waves of the sea from the north incessantly beat against it. From the ground to the middle gallery or stage the measurement is exactly seventy fathoms, and from this gallery to the summit, twenty-six.*

"We ascend to the summit by a staircase constructed in the interior, which is as broad as those ordinarily erected in towers. This staircase terminates at about half-way, and thence the building becomes much narrower. In the interior, and under the staircase, some chambers have been built. Starting from the gallery, the pharos rises to its summit with a continually increasing contraction. until at last it may be folded round by a man's arms. From this same gallery we recommence our ascent by a flight of steps of much narrower dimensions than the lower staircase: in every part it is pierced with windows to give light to persons making use of it, and to assist them in gaining a proper footing as they ascend.

"This edifice," adds Edrisi, "is singularly remarkable, as much on account of its height as of its massiveness; it is of exceeding utility, because its fire burns night and day for the guidance of navigators: they are well acquainted with the fire, and steer their course in consequence, for it is visible at the distance of a day's sail (!). During the night it shines like a star; by day you may distinguish its smoke."

* These measurements amount to 576 feet; but we fear the Arabian writer was incorrect in his calculations.

This latter passage shows that if any better mode of illumination had once been in use, as we are inclined to believe, it had been discontinued, or its secret forgotten, by the degenerate successors of the Alexandrian Greeks.

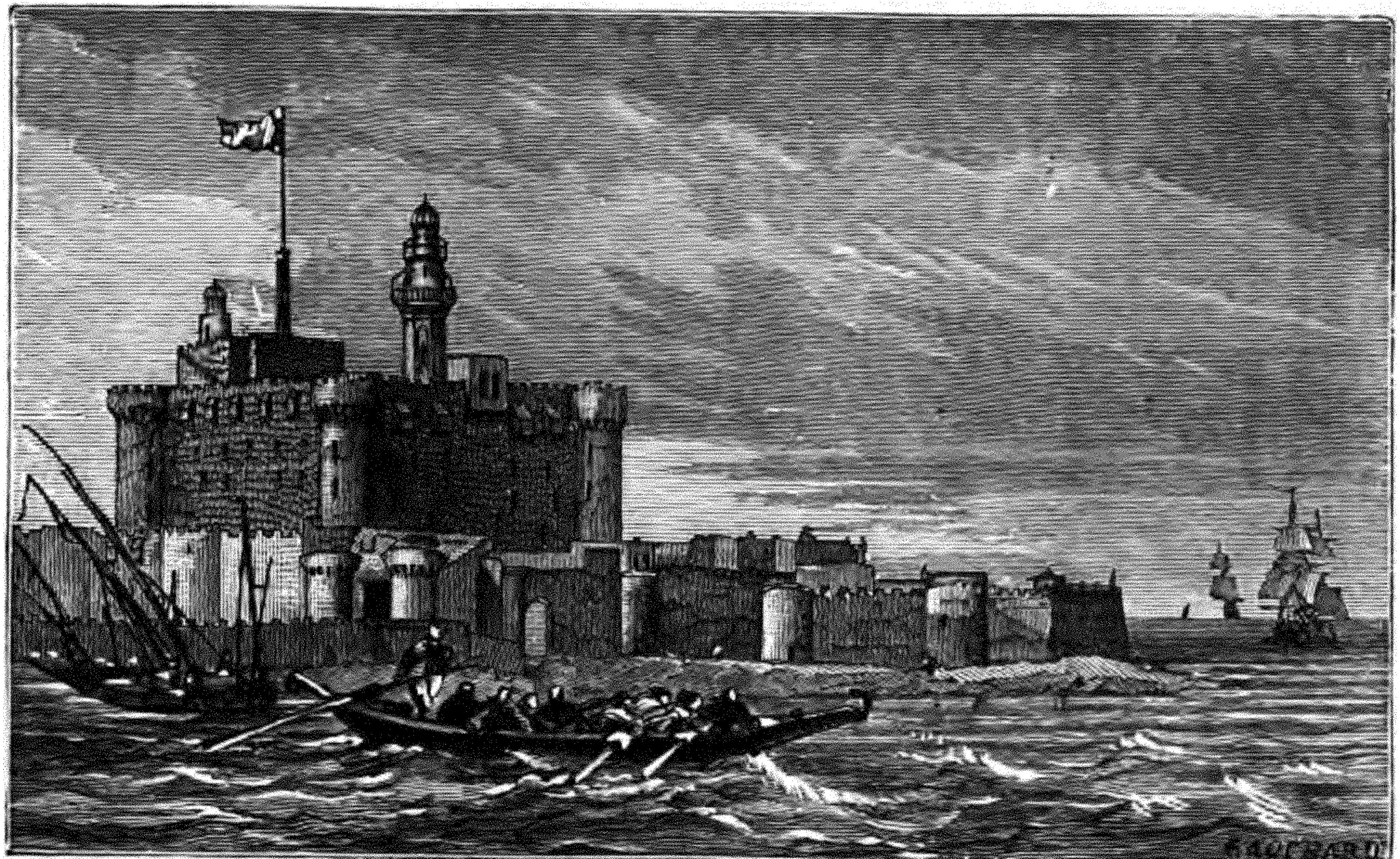
Edrisi remarks, in language resembling Pliny's, that from a distance the light of the pharos was so like a star which had risen upon the horizon, that the mariners, mistaking it, directed their prows towards the other coast, and were often wrecked upon the sands of Marmorica.

Montfaucon also records this unfortunate peculiarity, which, however, is not unknown in our own days. More than one of the lighthouses intended to warn the seaman as he approaches a dangerous rock or headland now carries a couple of lights: one at the summit, and one below; that the upper may not be mistaken for a star.*

In reference to the Alexandrian pharos, Montfaucon remarks that the stories related by the Arabs and European travellers must be very cautiously examined. For instance: we are told that Sostrates rested its foundations on four huge crab-fish made of glass (*grands cancres de verre*); a fable so gross, says one Benedictine, that it is not worth the trouble of refuting it, though Isaac Vossius declares it to be recorded in an ancient manuscript which he himself possessed.

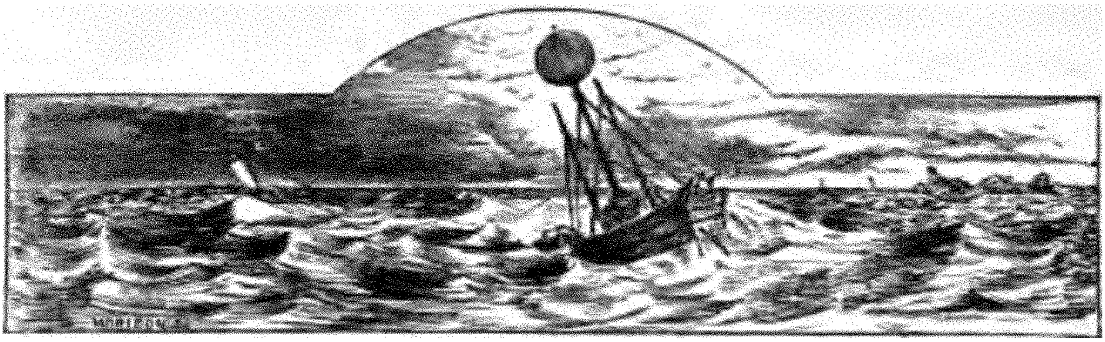
Nor, continues Montfaucon, are we more disposed to credit the story told by Martinus Crusius, in his *Turco-Græciæ*, book viii.—on the authority of the Arabs—that Alexander the Great fixed on the summit of the tower a mirror so skilfully made that it revealed the approach of

* Renard, "Les Phares," p. 16.



MODERN LIGHTHOUSE OF ALEXANDRIA.

hostile fleets at a distance of one hundred leagues, and that after the Macedonian hero's death it was broken by a Greek, named Sodores, while the guardians of the light-house slept. But, unfortunately for this romantic fiction, the pharos was not built until after the time of Alexander the Great.



CHAPTER III.

THE "TOUR D'ORDRE" OF BOULOGNE.

BOULOGNE is the ancient *Bononia* or *Gesoriacum*, "a naval place," says Ptolemæus, "of the Morini," and distant from the British coast, according to Pliny, about fifty *millia passuum*. Pliny probably measured from Boulogne to *Rutupiæ* (or Richborough), where the Romans had a fortified port, and which was their usual landing-place from Gallia. His measurement, however, exaggerates the actual distance between these places.

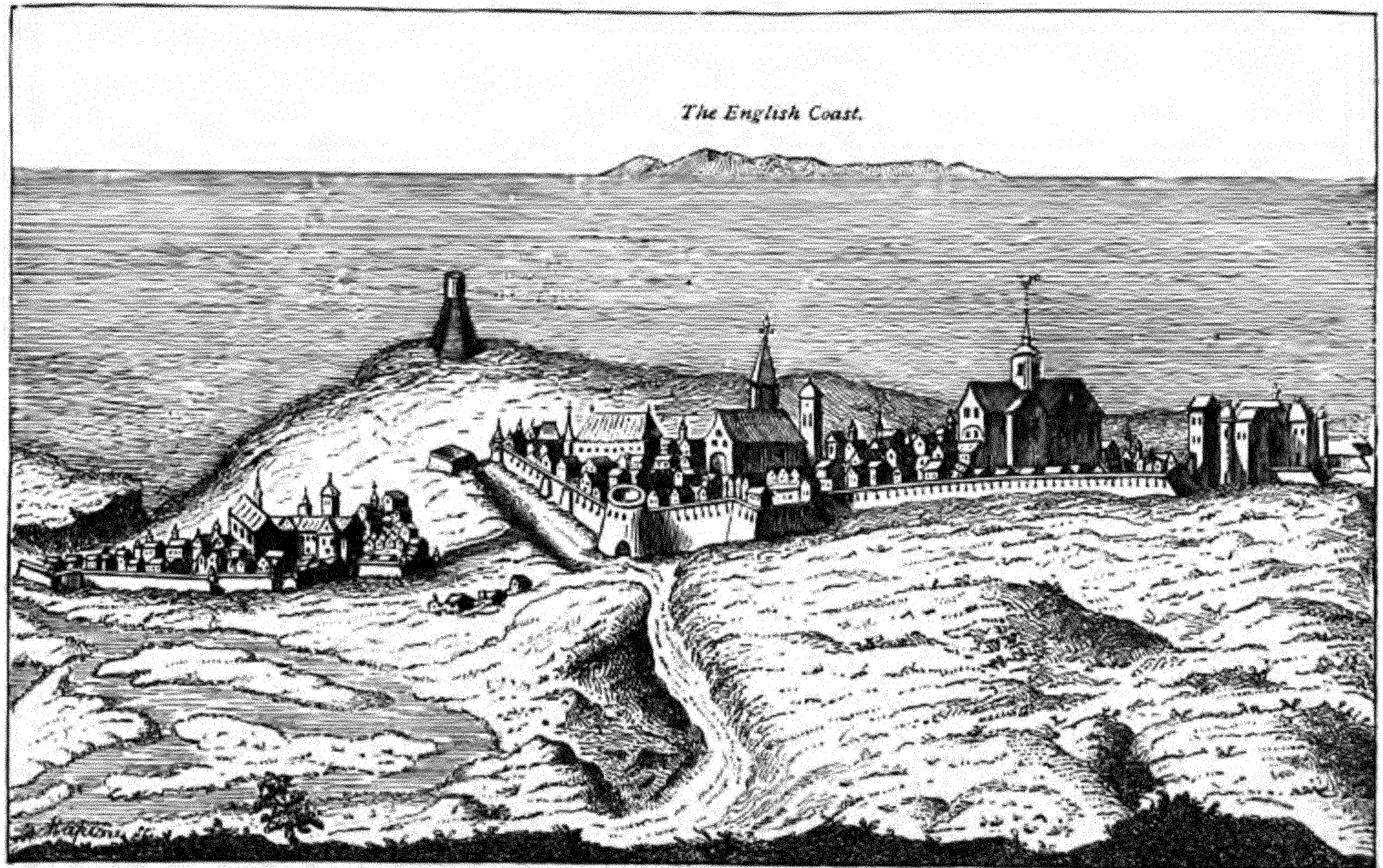
It was from Boulogne the Emperor Claudius embarked on his expedition to Britain; and it was at Boulogne the Emperor Caligula bade his soldiers collect the shells as spoils of ocean, and decreed himself a triumph for victories he had only won in imagination. As a more durable monument of his achievements, he erected, according to Suetonius, a lofty tower; the extraordinary structure which, under the name of the *Tour d'Ordre*, for centuries extorted the admiration of men.

Built as a memorial of imperial vain-gloriousness, when was it first converted into a work of public utility? When did the triumphal tower become a lighthouse? To these questions we can offer no authoritative reply. But it seems probable that in A.D. 191 a light was blazing from its summit; for a bronze medal of Commodus—on which he is entitled Britannicus, in memory of his lieutenant's victories over the Britons—represents the pharos and its fire, and the departure of a Roman fleet.

Planted at the usual point of embarkation for Britain, the tower of Boulogne was carefully preserved so long as the Roman sway endured. In 811 it was repaired, according to Eginhard, by the great Western emperor, Charles, who was then preparing an expedition against the Norman pirates. As late as the seventeenth century it seems to have been employed as a lighthouse; and thence, according to a popular but certainly erroneous etymology, its ancient name of *Turris ardens* became, by corruption, *Tour d'Ordre*. It also served as a fortress, for which it was well adapted by its admirable position and extraordinary massiveness.

In the sixteenth century, while Boulogne was occupied by an English garrison—that is, from 1554 to 1559—the *Tour d'Ordre* was enclosed by two ramparts, one of brick, the other of earth, and both furnished with artillery. This point was felicitously chosen for the attack or defence of Boulogne, inasmuch as it dominated over the whole town, and commanded both banks of the Liane. Yet the Tour d'Ordre suffered little from the ravages of war, except that its lantern was several times destroyed; and its ruin is wholly due to the neglect of successive magistrates of Boulogne. Shaken at first by the waves, which in high tides dashed furiously against the cliff—then by the subterranean action of springs and watercourses—and, finally, by the imprudent excavation of the adjoining quarries, both the fort and the tower fell down—twice, according to some authorities—thrice, according to others—between 1640 and 1645—along with the portion of the cliff on which they were erected.

In the interval between these sad events, says Egger, nothing was attempted in preservation of the remains of our precious monument, which, however, in its ruined condition, still served as a night-beacon for ships entering the port. When at length it perished utterly, the municipality of Boulogne considered themselves released from the dues which, for this portion of their territory, they had paid, in virtue of an ancient right, to the Seigneur de Bainethun. As the soil no longer existed, the tenants thought themselves freed from all obligations towards its proprietor. The latter resorted to legal proceedings, and judgment was given in his favour, July the 1st, 1656. Inasmuch as the wise men of Boulogne had by their own negligence caused the loss which they put forward as an excuse for denying their debt, they were condemned to pay, as before, two thousand herrings, fresh and dry, to be delivered at Arras, Amiens, and other towns, according to the seigneur's pleasure—or to restore the ground to its ancient condition, and abandon to the Seigneur de Bainethun the toll which they levy from all fishermen entering the harbour. And there is reason to believe that this tribute of two thousand herrings was paid by the corporation of Boulogne down to the epoch of the French Revolution.



BIRD'S EYE VIEW OF THE TOUR D'ORDRE OF BOULOGNE.
(*From an old drawing by Claude Châtillon.*)

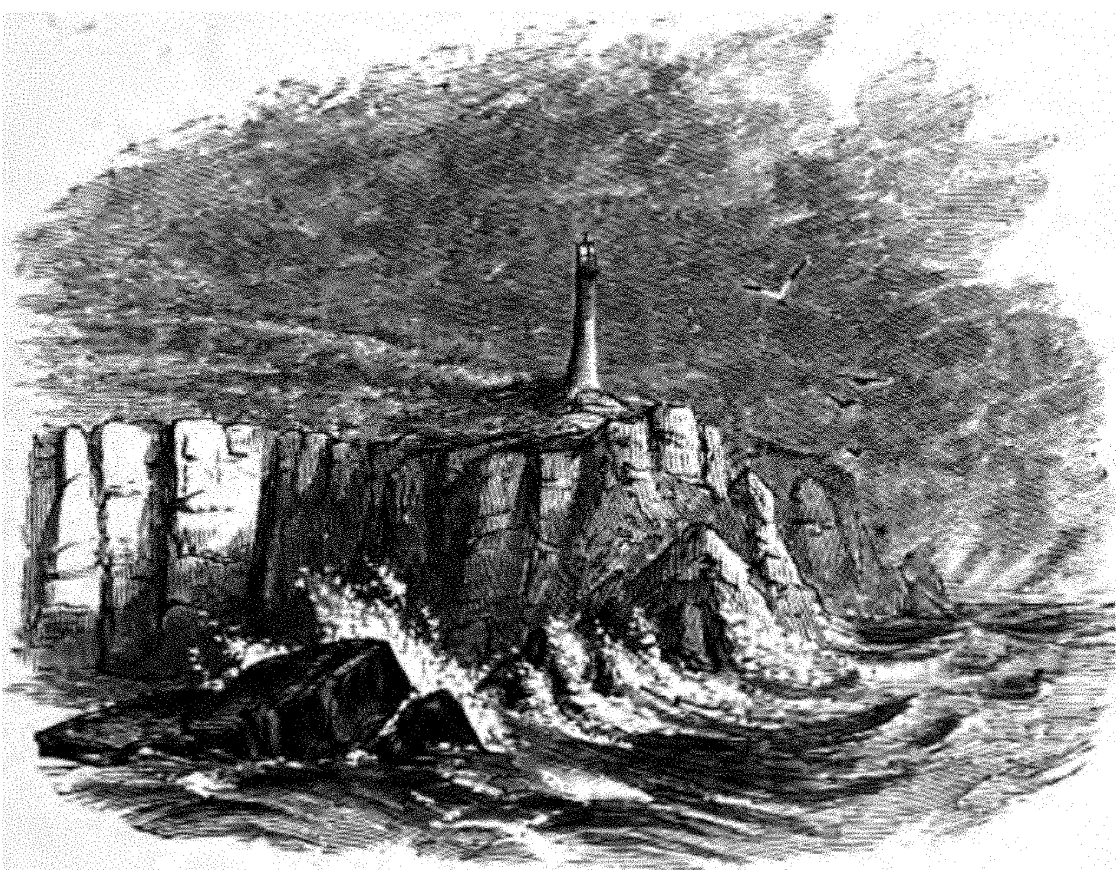
There are little, if any, remains now extant of this ancient monument, more glorious from the services which for generations it rendered to humanity than from its origin, which only recalled the extravagance and insane ostentation of Caligula; and M. Egger advises us to be cautious how we place our confidence in the representations which have been given of it. The most trustworthy seems to be the drawing executed by Claude Châtillon, engineer to Henry IV., which we here reproduce.

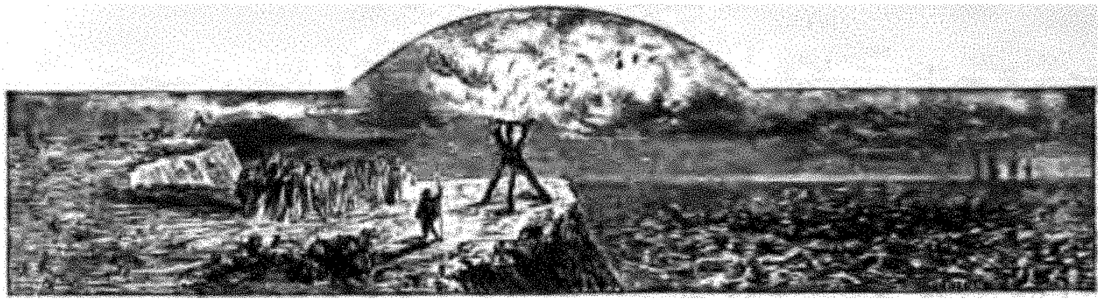
The descriptions which are on record, says M. Renard, are equally unsatisfactory. Still we can pick out of their rhodomontade some few valuable and accurate particulars of its situation, dimensions, and form, and of the materials employed in its construction. These were simply gray and yellow stones, and red bricks, so arranged as to compose an edifice of great solidity and yet of attractive appearance. The tower was situated some two or three hundred yards from the brink of the cliff; it was octagonal; 192 feet in circumference, and about 64 feet in diameter: as with most of the Roman pharoses, each of its twelve stories was a foot and a half narrower than the story immediately below it, so that it assumed, on the whole, a pyramidal shape. We are told that its height was about equal to its circumference, or, in round numbers, 200 feet —which seems, as Egger remarks, an extraordinary elevation for a lighthouse, already situated on a cliff 100 feet above the sea-level. According to M. J. F. Henry, its height was about 124 feet. However this may be, each story had on the south side an opening like a gate. As late as the beginning of the seventeenth century there might still be seen three vaulted chambers, one above the other, connected by an inner flight of stairs, and probably intended for the lodging of the keepers.

As for the place where the fire or light was kindled, we are entirely left to conjecture; but from the fact that the chroniclers of the ninth century assert that the summit was repaired with a view to prepare it for the signal-fires, there seems reason to believe that before this restoration they were kindled in a chamber on the uppermost story.

M. Egger puts forward the supposition that carefully directed excavations might lead to the discovery of important remains. And looking to the arguments by which he supports his hypothesis, we are disposed to accept it as very plausible. It is to be regretted that France possesses no archæological associations to undertake the superintendence and prosecute the study of her memorials of antiquity. With all her passion for national aggrandizement, she proves herself strangely neglectful of her past, and the educated classes of France exhibit little of that interest in archæological and antiquarian pursuits which is shown by the scholars and gentry of England. Yet on every ground it is desirable that a nation's past should never be divorced from its present; that the continuity of national life should, as far as possible, be preserved unbroken; and much may be done for the furtherance of so desirable an object by a due regard to the monuments erected by our forefathers.

The *Commission des Phares* has raised, however, in the place of the Tour d'Ordre, a worthy substitute. In 1835 it established at Boulogne a red light, fixed, and two other fixed lights, the first of which shed its radiance for four, and the second and third for nine miles; ample illumination this for a portion of the French coast which is already lighted, at Cape Grisnez, by a powerful apparatus, whose lustre extends as far as twenty-two miles, and at Pointe d'Alpreck, by a lighthouse visible for twelve miles.





CHAPTER IV.

THE TOWER AT DOVER.

THE summit of the lofty down at Dover, now crowned by the famous castle, with its Norman keep and towers, was used as a military post from a very remote antiquity. There can be little doubt that the Britons here kept watch and ward: that it was the site of a Roman stronghold, we know from indisputable evidence. A circular entrenchment of Roman work is still extant, and so too are the remains of the Roman lighthouse, whose steady blaze lighted the imperial galleys as they hovered about the port, or guided the British oyster-boats returning from their market at Boulogne.

With the history of the stronghold, however, we have nothing to do. It is the pharos which attracts our steps, and induces us to ascend the steep acclivity. A recent antiquary is of opinion that there were *two* lights; one on the eastern, and the other on the western edge of the hill. The ruins of the latter are so shapeless and indistinct that no description of them could interest the reader, or enable him to picture to his "mind's eye" the form and structure of the ancient edifice. Of the former enough remains to assist our imagination very materially.

THE TOWER AT DOVER.

It is still, says Mr. Puckle,* a massive shell: the inner face of its walls vertical and squared, the outside with a tendency to a conical form, which was probably at one time much more distinct, allowing for the quantities of external masonry and facing which by degrees must have fallen or been hewn away. The basement only is of Roman work; the octagon chamber above having been

* Rev. J. Puckle, "Church and Fortress of Dover Castle" (ed. 1864).

added in the reign of Henry VIII. The dimensions are abou̒t fourteen feet square.

The following description we borrow from Mr. Puckle's learned monogram :—

Except fragments here and there, he says, such as might have been picked up along the shore, the materials used in the pharos are few and uniform throughout; each having its own peculiar character, quite distinct from any supposed similar materials of subsequent date.

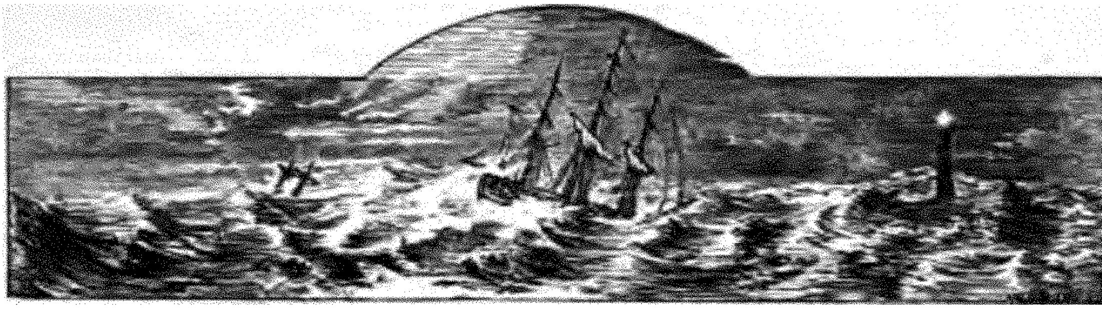
"1. *Tufa:* A substance freely used by the Romans wherever obtainable, and always considered to mark their work as certainly as if dated and recorded in some historical document. Quantities of it may still be dug in parts of the valley of Dover, by the river. It was squared up, and used in tolerably regular courses of blocks; those inside showing a fair and even facing, hard, and little friable either by age or weather.

"2. *The concrete, or mortar:* This is of two kinds, found at two levels of the lower mass of the tower. A small portion has been laid in a pale, tawny-coloured mortar, mixed in the proportion of four parts of sharp grit to one of lime. The greater part, however, has been carried up with the pink or salmon-coloured mortar, peculiar to Roman work, and mixed in the proportion of one part of lime to four of more or less finely-pounded Roman brick. It is nothing like so hard as the concrete found (for instance) lining the Roman baths discovered under the west end of the nave of St. Mary's parish-church; but it is too peculiar a material not to be recognized wherever it appears, identifying its Roman make.

"3. *The red tile-brick:* This, again, is always esteemed a very distinctive element in materials of Roman building; but it requires some attention to distinguish justly between the genuine Roman production and subsequent imitations of the same thing. Without digressing into the habits of a Roman brick-yard, it may suffice just to refer to what is described in well-known ancient authorities, as the careful process observed in the making of Roman tile-brick. A very pure and smooth clay was selected, and so treated as to expel as much as possible all gritty and non-homogeneous ingredients. Reduced to something like the fineness and consistency of dough, it underwent a treatment not very different from that of the dough itself; being laboriously wrought and tempered by hand or otherwise, like bread being kneaded in its trough; it was then shaped off in flat blocks of the various sizes employed. The sizes vary considerably as found in different places; but those commonly seen along the Kentish coast in bonding-courses, or the construction of arches, are something over a foot square, by about two inches in thickness. They are generally more or less deeply scored on the under face, either in a rude pattern, or simply with straight or wavy lines, making their hold on hard mortar very tenacious; though these are not unfailing marks of Roman brick."

Such are the materials of which the Roman pharos was constructed; materials identical with those which compose the Tour d'Ordre at Boulogne. When it was first disused as a lighthouse, it is impossible to say; but as its elevation must have constantly enveloped it in mists, and rendered its fires useless, we should opine that it was not employed after the Conquest. In course of time it was devoted to military purposes, its lower chamber being converted into a guard-room; and of late years it has been appropriated as a government store-house. Lights are now established on the piers of Dover Harbour, and with those of the South Foreland on the English coast, and of Cape Grisnez and Boulogne on the French coast. amply suffice for the due illumination of the Straits.

It is much to be desired that every care should be taken for the preservation from further injury of so interesting a relic of Roman times as the pharos at Dover.



CHAPTER V.

THE COLOSSUS OF RHODES.

"MEN receive with indifference from one another, and without examination, the traditions of past events, even of events connected with the history of their own country. Thus, for the most part, in their indolence to search out the truth, they accept at once all the fables and exaggerations forced upon their notice."

It is thus that Thucydides expresses himself; and though his observation is two thousand years old, it has lost nothing of its point or truth.

A striking example of its applicability is afforded by the striking illustration now before us;—a representation of the Colossus of Rhodes, according to the generally received idea that this celebrated statue of Apollo was planted at the entrance to the harbour of Rhodes, where it served as a pharos; and that it was of such surpassing magnitude that ships under full sail could pass between its gigantic limbs.

But there is no evidence that the Colossus ever served as a pharos; at least, no ancient author asserts that such was its employment. The first writer who converted it into a beacon-light was Urbain Chevreau, an industrious but not particularly able compiler of the seventeenth century; but he neglects to say from what source he obtained his information.

In the second place, the attitude traditionally ascribed to the Rhodian Colossus—an attitude neither graceful nor dignified—is also a pure conceit of comparatively modern times. It is, however, more ancient than the former, since it dates from the sixteenth century, when Blaise de Vigenère, the translator of Philostratus, transformed the masterpiece of Chares, the pupil of Lysippus, into a fantastic impossibility. Where he, too, obtained his information, no one can ascertain; for on this important point he preserved the prudent silence of Chevreau.

In an interesting paper, published by the French *Académie des Inscriptions*, the Comte de Caylus proves—1st, That the Rhodian Apollo was not constructed at the mouth of the harbour; and 2nd, That no ships ever passed between its legs. He did not satisfy everybody, however, and reference was made to the pages of the geographer Strabo. It was found that he made no mention of the remarkable circumstance narrated by Vigenère. He cites a fragment of an epigram in iambic metre, in which the name of [illegible] sculptor, Chares of Lindos, is mentioned, and the d[illegible] of his work—namely [illegible] cubits—are give[illegible] adds that the Co[illegible] time, lay prostr[illegible] ground—ov[illegible] earthquake, and [illegible]ered kn[illegible] Rhodians had n[illegible] to it[illegible] bidden by an or[illegible]

Turning to Pliny, we find that he confirms all the statements of Strabo, and fixes the date of the fall of the statue at fifty-six years after its erection. Though overthrown, he says, it is still a marvel. Few men can embrace its thumb; its fingers are larger than those of statues. Its disfigured limbs appear so many vast caverns; and in the interior the enormous stones are seen with which they had been weighted. It cost, says Pliny, 300 talents; being exactly the sum of money which the Rhodians plundered from the war-ships abandoned before their city by Demetrius, when he raised the siege, after protracting it for many months.

Philo of Byzantium, a mechanician who lived about the end of the third century B.C., and to whom is attributed a brief treatise on the "Seven Wonders of the World," describes at some length the Rhodian Colossus, but makes no allusion to its supposed straddling attitude, or to its employment as a pharos. The same silence is preserved by another historian of the Seven Wonders, Lucius Ampellius. But as he possessed, like Chevreau and Vigenère, an inventive faculty, this author says: "At Rhodes is the colossal statue of the Sun, placed on a marble column, with a chariot drawn by four horses."

Putting aside the embellishments of tradition, let us inquire what this monument really was:—

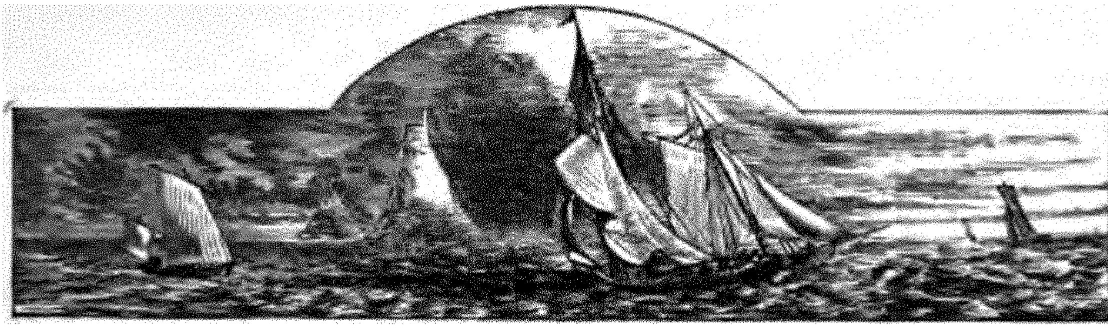
The brazen statue of Helios, popularly called the Colossus, was seventy cubits in height; its gigantic size may be inferred from the fact that few could compass one of its thumbs with their arms.* Fifty-six years after its erection it was overthrown by an earthquake (*circa* B.C.

* Strabo, xiv., p. 364; Pliny, xxxiv. 18.

224), and as already related, the Rhodians would not attempt its restoration, though Ptolemæus offered them a contribution of 3000 talents, because prohibited by an oracle. And yet later authorities describe it as standing erect; and the Emperor Commodus, among his other extravagances, ordered his bust to be set upon its summit.

In 672 Rhodes was captured by the Saracens, and their leader, one of the lieutenants of Othman, sold the brass of which the famous statue was composed, to a Jewish merchant of Edessa, for a sum, it is said, of £36,000. The bargain must have been very profitable, if it be true that the materials thus acquired loaded a thousand camels.

A few words may be added in reference to the sculptor of the Colossus. According to Pliny, he was a pupil of Lysippus, a native of Lindos, and named Chares. Such, too, is the evidence of Strabo and the anonymous author of the Greek epigram. But in the writings of the Pyrrhonist, Sextus Empiricus, we find the honour of the achievement ascribed to one Laches. According to Sextus, Chares, discovering that he was cheated of half the sum of money promised for the completion of the statue, killed himself in despair; and Laches, succeeding him, perfected the glorious work. The authority of Pliny and Strabo, however, seems to us preferable to that of Sextus: the Colossus was truly the work of Chares, alone and unaided, and to him belongs the glory of having, as Philo of Byzantium says, "Made a god like to a god, and endowed the world with a second sun."



BOOK II.

THE SCIENCE OF LIGHTHOUSES.

CHAPTER I.

HOW THEY ARE ADMINISTERED.

FROM antiquity we return to our own time, with the view of examining the present condition of our coast-defences, so far as they include the lighthouse, the lightship, the beacon, and the buoy.

To England belongs the praise, among modern nations, of having first understood all the importance of lighthouses, and of having made their erection, mode of illumination, and maintenance, a matter of national concern.

The direction of the Imperial lighthouses is confided to three Boards—one for each of the three kingdoms :—

1st, The *Corporation of the Trinity House of Deptford Strand*, who possess the control of all the English lighthouses ;—

2nd, The *Corporation of the Commissioners of Northern*

Lights, to whom is intrusted the management of the lighthouses of Scotland; and,—

3rd, The *Corporation for Preserving and Improving the Port of Dublin*, who administer the coast-illumination of Ireland.

The history of the TRINITY HOUSE is but imperfectly known, owing to the destruction of a considerable portion of its archives by fire in 1714. It was founded by a charter of Henry VIII.—who may almost be called the Father of English Navigation—on the 20th of March 1512, and received the appellation of the "Brotherhood of the Trinity House of Deptford of Strand and St. Clement." This document opens with a curious declaration:—"Out of the sincere and complete love and devotion which we have for the very glorious and indivisible Trinity, and also for Saint Clement the Confessor, His Majesty grants and gives license for the establishment of a corporation, or perpetual brotherhood, to certain of his subjects and their associates, men or women."

At the outset, the duty of the members of the guild seems simply to have been to pray for the souls of sailors drowned at sea, and for the lives of those who were battling against the tempest. After a while their functions increased in number, and, assuredly, in importance. The charters which they received from Elizabeth, James I., Charles II., and James II., placed in their hands the general control of the mercantile marine, and even, under certain conditions, of the royal fleet. The illumination of dangerous parts of the English coast necessarily became a portion of their mission of patriotic beneficence. But the reader must not suppose that no lighthouses burned along our shores until the Trinity House was established. Rude signal-lights and beacon-fires already blazed on rocky headlands, and at the mouths of the ports most frequented by our shipping; but a greater number of lighthouses became necessary, and on a more perfect system of organization, as English commerce in the seventeenth century assumed its extraordinary development.

But this was not all. The constructors of private lights and beacons were not animated by a pure unadulterated zeal for the public welfare; they levied excessive tolls on the vessels which profited by their guiding rays. To erect and maintain a lighthouse constituted an industry of so profitable a character that the privileges in virtue of which they existed, and which were nearly all found in the hands of the Trinity House, excited a very widespread feeling of jealousy and discontent. The legislation which had taken place on this subject was rigorously examined, and as a result these privileges disappeared. This important discovery was made in the reign of James I. The king found himself specially interested in making it; for, by its return to the crown, the monopoly of licensing the erection of lighthouses would have largely increased his private income.

The pretensions put forward by James I. greatly embarrassed the judges charged with the examination of the rights of the Trinity House; and the inquiry might have lasted for years had it not been abruptly concluded, after our English fashion, by a compromise. It was decided that the fraternity of the Trinity House should be authorized to erect lighthouses, but that the crown should enjoy the same privilege in virtue of the common law. From this decision it naturally came to pass that, instead of remaining, as Elizabeth had designed, the exclusive property of the Trinity House, the lease and monopoly of the fires lighted on the coasts were granted or sold by the sovereign to certain private individuals.

As a result of this decision, says M. Esquiros, in his lively manner, there was not a bare and desolate angle of rock in the kingdom which was not coveted by speculators as a site for a tower and a beacon-fire. Lord Grenville, an able statesman and shrewd man of the world, wrote in his diary in the form of a note or memorandum: "*Mem.* To watch the moment when the King is in a good temper, to ask of him a lighthouse." It would be difficult to estimate the amount realized by those persons whom the king favoured with such marks of his good-will; but from the luxurious state they maintained it is evident their profits must have been immense.

We may readily conjecture the evil results of such a system. Many of the lights were deficient in power; others were never kindled; yet in every case heavy tolls were exacted from passing vessels. At length the scandal grew intolerable, and in the reign of William IV. Parliament interfered to establish a certain uniformity in the administration of lighthouses, and to provide for a considerable reduction of the dues. All the interests of the Crown were made over to the Trinity House, which, moreover, was empowered to buy up the lighthouses belonging to private individuals; and the Corporation having always acted with singular zeal, efficiency, and public spirit, the system of our coast-defences has gradually attained to a remarkable degree of completeness.

A word or two may now be said on the interior organization of the Trinity House. It includes two bodies of associates: the *Elder*, and the *Younger Brothers*. At first no such distinction existed; but the pretext put forward to justify the exclusion of the Younger Brethren from sharing in the conduct of the Society was, that they showed too much fervour at its meetings. The Younger Brethren, now-a-days, are chosen by the Council on the motion of one of the Elder Brethren. Their number was formerly unlimited. It cannot be too large, say the ancient charters, because our seamen represent the strength of the nation. At the present time there are 360.

The Elder Brethren, 31 in number, are chosen from the Younger. No one can offer himself as a candidate if he has not first undergone an examination, and served for at least four years as captain on board a Queen's ship or a merchant-vessel. On his election he pays £30 as a contribution to the poor-box, and an equal sum for a complimentary dinner.

The Elder Brethren, however, are divided into honorary and active members. From a very early period, the Company recognized the advantage of including in its ranks the most illustrious living Englishmen, even though they should in no wise be concerned with navigation. In 1673, the Bishop of Rochester, having preached before the Corporation on Trinity Thursday, was admitted a member. For seventeen years William Pitt occupied the honourable position of Master, which was afterwards filled by William IV., when Duke of Clarence. Wellington, Prince Albert, and Lord Palmerston, formerly belonged to the Corporation; and, at present, the Prince of Wales, the Right Hon. W. E. Gladstone, and Earl Russell, are among its members, while the Duke of Edinburgh officiates as Master. These honorary members, limited to eleven, do not engage in the administrative duties of the Trinity House; but they add to its dignity, and serve to connect it with the highest classes of English society. In fact, it would be difficult to name an association which is more truly national in character.

The twenty active members, on whom the real burden of the work of the Corporation rests, are experienced captains of men-of-war or merchant-ships, who have retired from service. They are formed into six committees, each of which has its separate functions; for, in addition to its superintendence of the lighting of our coasts, the Trinity Board examines our pilots, and delivers them their certificates; watches over the ballasting of ships in the Thames; establishes and keeps in order the various sea-marks; examines the scholars of Christ's Hospital, who are intended for a maritime career; collects the revenues; and superintends the boarders in the houses of refuge which belong to the Corporation. Its charters, moreover, confer upon it the right of punishing seamen for mutiny, ill conduct, or desertion; but this power is now-a-days never exercised.

The story of our two other Corporations may be briefly told. The *Commission of Northern Lights*, incorporated in 1786, by an Act of George III., is composed of two magistrates appointed by the Crown, of the sheriffs of the sea-board counties, of the provosts of certain royal burghs, and of the provost of Greenock.

The *Board of Ballast of Dublin*, which has under its charge the lightage of the Irish coast, consists of merchants, bankers, magistrates, railway directors; and the only seaman associated with them is a coast-guard officer. It is subordinate to the Board of Trade.

The Trinity House, Northern Lights, and Ballast Board are under the control of the Board of Trade. Before new lighthouses are erected by the Trinity House, they must be sanctioned by the Board of Trade; and before Scotch or Irish lighthouses are erected, the Trinity House are consulted, and in the event of that Board differing with the Irish or Scotch, the Board of Trade give their decision, which is final. It is to be regretted that there should still exist a considerable number of lighthouses which are under the control of about one hundred and seventy local authorities; * and every person who appreciates the importance of securing a vigorous and able administration will join us in expressing a hope that before long the lightage of the United Kingdom may form the subject of efficacious legislative action.

The number and nature of the lights of the United Kingdom are as follows:—

* See Report of the Royal Commissioners on Lights, Buoys, and Beacons, 1861.—*Edinburgh Review*, Jan. 1862, p. 173.

In England: lighthouses, lights on piers, harbour lights, &c., 237. Add 49 lightships—total, 286.

In Scotland: lighthouses, lights on piers, harbour lights, &c., 134. Add 1 lightship—total, 135.

In Ireland: lighthouses, lights on piers, harbour lights, &c., 85. Add 8 lightships—total, 93.

The general result for the United Kingdom is, that we have 456 lighthouses, harbour lights, local lights, &c., and 58 lightships. Total, 514.

We may compare these figures with those of the French lights.

Coast-line of England	measures	2405 nautical miles.
Coast-line of Scotland	"	4467 nautical miles.
Coast-line of Ireland	"	2518 nautical miles.
Coast-line of France	"	2763 nautical miles.

Now France has 224 lighthouses, but no floating lights. The proportion of lights to the coast-line is,* therefore, as follows:—

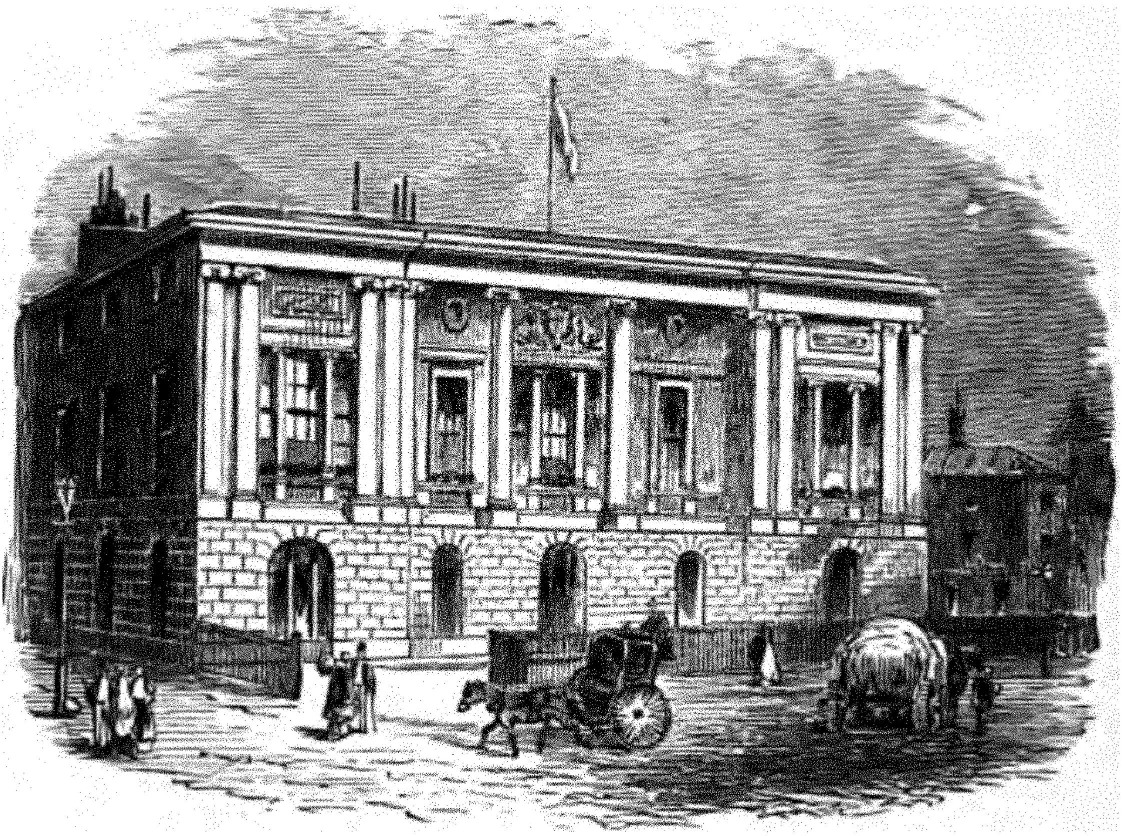
In England	1 to every 8½ miles (nearly).
In Scotland	1 to every 33 miles.
In Ireland........	1 to every 27 miles.
In France..... ...	1 to every 12.3 miles.

We may here explain the French system of administration, which, however, cannot be said to equal our own in efficiency or comprehensiveness, nor to surpass it in

* This proportion will be slightly modified, but not materially, if we deduct the harbour and pier lights from the English, Scotch, and Irish totals.

economy. At all events, the foregoing figures show that the English coast is far more numerously lighted than the French.

The French system dates from the beginning of the present century, and is administered by the Department of *Ponts et Chaussées*, composed of naval officers, hydrographic engineers, members of the French Institute, and other persons acquainted with the sciences which bear upon navigation. The general direction of the service is committed to the Inspector-General of Ponts et Chaussees, who has under his orders a certain number of engineers, in each maritime district, charged with the supervision, construction, and administration of lighthouses. This board or directorate has its own manufactories in Paris, where experiments are tried with lighting apparatus, and where the artisan receives all the information necessary to guide him in the construction of every part of the apparatus, such as the calculation of angles, prisms, curves, lenses, and the like. One of the best results of this centralization is the economy it insures; the entire cost of the French service not exceeding £40,000 per annum. It may be added, that to France, as to the United States, belongs the praise of having looked upon the lightage of her coasts, not as a source of public or private revenue, but as a work of humanity. We trust that England, before any long period has elapsed, will abolish the tolls now levied upon shipping for the maintenance of her lighthouses. We admit that they have been considerably reduced; but they still remain a burden upon commerce, and a burden which commerce ought not to bear.



TRINITY HOUSE.

Let us now pay a visit to the *Trinity House*, in London, taking as our guide the shrewd and lively author of "The English at Home."

Opposite the Tower of London, he says, or, more strictly speaking, opposite the ancient fosses of that fortress, now converted into an agreeable promenade, extends a fine open area of green turf, edged round with shrubs; and, in the rear of this square, rises an edifice which seems purposedly to isolate itself from the noise of the multitude— it is the Trinity House.

The abode of this important maritime Society was formerly situated in Water Lane, whence it was driven out by two successive conflagrations; otherwise, could any better choice be made than the immediate neighbourhood of the Thames, of the great docks, and of the forest of masts which crowds it for many miles, like the parks or plantations of great trees which surround at a distance the manorial mansions of the English aristocracy?

The principal features of the edifice, erected in 1793 by James Wyatt, are, a massive basement, surmounted by a single story enriched with Doric columns and pilasters, the whole built of Portland stone. On the façade, numerous genii, which, with round faces and puffed-out cheeks, might be taken for so many cupids, hold in their hands anchors, compasses, and marine charts. These emblems, however, sufficiently indicate the character of the institution.

The ground-floor in the interior is occupied by offices; the upper contains some noble apartments, to which admission can only be procured by special favour. A noble vestibule leads to a double staircase of stone, whose two branches, after ascending in different directions, unite in a central landing-place, enriched with ornaments and sculptures. On the right, in a semicircle described by the wall, is framed a large oil painting, by Gainsborough's nephew, representing a body of *past* "Elder Brethren," grouped together, and in uniform. On the left, in panels of glass, are inscribed the names of various benefactors of the establishment, and the amount of their bequests. Massive doors of mahogany introduce the visitor into the Board Room, whose ceiling, painted in 1796, by a French artist named Rigaud, and loaded with sprawling allegories, exhibits the Prosperity of England as springing from Navigation and Commerce. The British Neptune advances in triumph, surrounded by sea-horses, and attended by Tritons. In one hand he carries a trident, in the other the shield of the United Kingdom. His march is protected by cannons and other instruments of war, while genii hovering round him wave the standard of Great Britain. The standard may pass muster; but cannons! Is not this an abuse of anachronism even for a picture? On the other side, Britannia, seated on a rock, receives in her bosom the products of different countries. Sea nymphs, bending under their weight of riches, hasten from every quarter, and seamen spread upon the shores of England the fruits of an extended commerce. Children wave to and fro their torches in representation of the lights which encircle the coasts of the British Isles, and during the darkness of night direct the movements of her ships.

The walls of this saloon are decorated with portraits of George IV., William IV., and their queens, for royalty itself is no stranger to the annals of the Trinity House, and monarchs honour themselves by figuring among the insignia of the fraternity of which they have been the members and the patrons. The Duke of Wellington's portrait, by Lucas, is considered the best in existence of the Conqueror of Waterloo. The busts of the Queen and the late Prince Consort, in white marble, by Noble—one of the few living sculptors who have attained to celebrity in England—rest solemnly at the two corners of the mantel-piece. Twenty arm-chairs ranged round a large table shaped like a crescent, and covered with a green cloth, mark the places of the members of the Council at their various meetings. The associates of the Trinity House think, with Ben Jonson, that good repasts encourage brotherly feeling. The dining-room, lighted by a kind of circular lantern which surmounts the ceiling, displays what may very justly be called a quiet and substantial luxury. Here we may remark the bust of William Pitt, by Chantrey; portraits of the Earl of Sandwich, the Duke of Bedford, Sir Francis Drake, and, especially, that of Sir Kenelm Digby, by Vandyke. At regular intervals, some excellent models of lighthouses in relief, preserved under glass, remind the visitor of the all-important object of this ancient Corporation.

The French Lighthouses Commission is not so splendidly lodged as the Trinity Board, nor is its Museum equal to the one at Edinburgh.* But, side by side with models of modern lighthouses, are models of the most ancient, from the ungainly tower whose summit was lit up with a rude fire of sea-coal, to the elegant edifice of the Heaux de Brehat. It also contains numerous examples of all the catoptric or dioptric apparatus which are, or have been, in use, as well as specimens of clocks, buoys, and beacons. The Lighthouse Museum is, finally, the central depot where experiments are conducted in reference to all the elements of maritime lightage, under the supreme direction of M. Emile Allard, the engineer-in-chief.

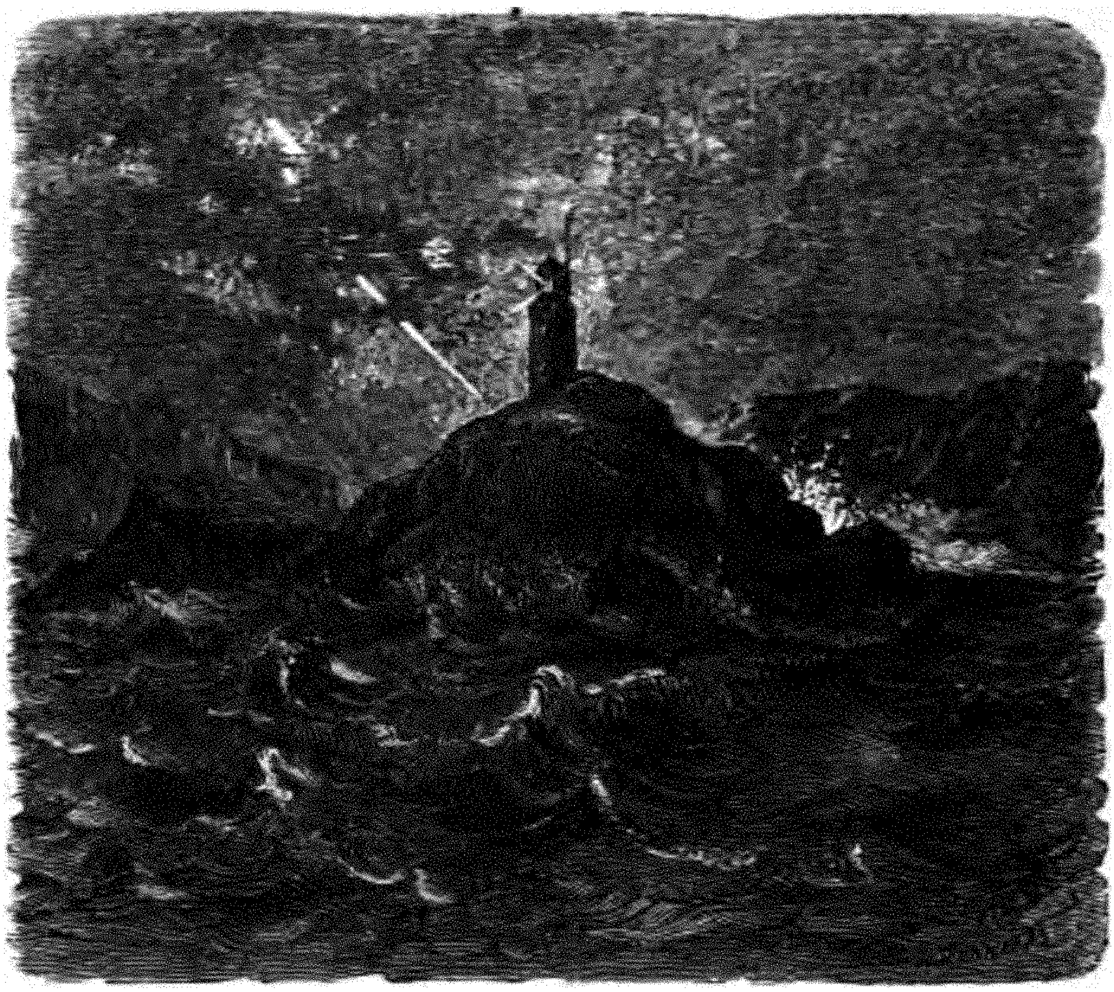
* We refer to the Exhibition of Lighthouse Models in the Industrial Museum.

CHAPTER II.

GEOGRAPHICAL DISTRIBUTION OF LIGHTHOUSES.

IN reference to the military protection of our coasts, the civilian is frequently warned of the necessity of maintaining more than one "line of defence;" a similar necessity exists as regards their complete and satisfactory lightage. We know, too, that at one point a battery is erected; at another, a simple earthwork is pronounced sufficient; at a third, the eye ranges over an intricate combination of forts. The same variety exists in the disposition of those coast-defences which are designed in the interests of secure and peaceful navigation. Follow, with the mind's eye, the long coast-line of our country, and how many differences we shall note in the situation of its lighthouses, in their mode of construction, their elevation, their system of illumination. Each pharos has, as it were, a speech of its own; each addresses, in significant language, the seaman who turns to it for advice or warning. This points out the entrance to a commodious haven, where, after being much tossed by unquiet waves, the weary mariner may repose in safety; that indicates the site of a perilous rock or sand-bank, on which a storm-driven vessel must assuredly perish. Here we see a noble tower, whose genial rays are visible at a distance of twenty-seven nautical miles; there burns a steady light, whose extent of illumination is restricted to five miles. One is a fixed light, glowing constantly like a brilliant star; another, more mysterious, suddenly flashes forth from the deep darkness, flings over the sea its arrow of flame, and then is again extinguished, to reappear, a few moments later, in the same strange and impressive manner. Nor are all lights of an uniform colour. Some are red, with an intense ruby-like splendour; others white; others, again, are blue or green. This variety in the range and aspect of the "beacon-fires" has, like the variety in the size and position of our forts and batteries, a special object.

The system of lightage generally adopted, says M. Renard, consists in surrounding the coast with *three* lines of defence; the outmost being composed of lighthouses with a very extensive range. It has justly been deemed of the highest importance to signal to the mariner the proximity of the land, since it is in the waters near the coast that navigation is exposed to the greatest dangers. The littoral presents a number of capes, promontories, and headlands, more or less projecting beyond the general level, as well as islets, and reefs, and shallows, which require to be carefully avoided. Now, lighthouses of the first class, as we may call them, or "sea-lights," are usually planted on these promontories or rocks; and along the British shore they are so arranged that it is impossible, except in a dense fog, to arrive in its neighbourhood without catching sight of one or more of them.



THE LIGHTHOUSE ON THE ROCKY HEADLAND.

When he has overpassed the first line of defence, the navigator encounters a second circle—"secondary-lights" —composed of lighthouses of the second and third orders, indicating secondary capes, reefs, and sand-banks, to which it is prudent to give a good offing. When the mouth of a river or the entrance of a port is only accessible by narrow channels, whose direction an experienced and veteran pilot can hardly determine by night, other lights of the same class are placed in the line of the channel, and point out the exact course which should be taken.

Finally, when the ship has arrived near the port which is the goal of her voyage, she perceives lights—

"harbour-lights"—upon its piers or breakwaters, which guide her to her much-wished-for berth.

When the best positions for illumination have been selected, the most difficult task is, or rather was, to provide for their easy distinction, so that the sailor may not be misled by too close a resemblance of one to another. Suitable variations and modifications have been, fortunately, supplied by the valuable labours of Fresnel, and of the engineers who have followed in his track.

At first, however, the embarrassment was considerable. Thus, the code laid down by the celebrated French Commission in 1825, admitted of only three characters for lighthouses of the first order: the "fixed light," the "revolving minute light," and the "revolving half-minute light." But it was soon discovered that merchant seamen did not sufficiently heed the differences observed between the intervals of the appearance and disappearance of the latter lights; and the number of lighthouses, moreover, having multiplied beyond all prevision, it became absolutely indispensable to allow of a greater number of distinctive characters.

Now-a-days we recognize five: the "fixed light," the "flashing light," the "revolving," the "intermittent," and the "double lights in one tower."

The "flashing light" is that which shows alternately two flashes and two eclipses, or more, in the interval of a minute.

The "flashing light," the "intermittent," and the "double lights in one tower" were all first proposed and introduced into Scotland by the late Mr. R. Stevenson.

The lustre of the "revolving light" gradually increases to a maximum, and diminishes to a minimum, until wholly eclipsed, at equal intervals of half a minute, one, two, or three minutes, and sometimes thrice in a minute.

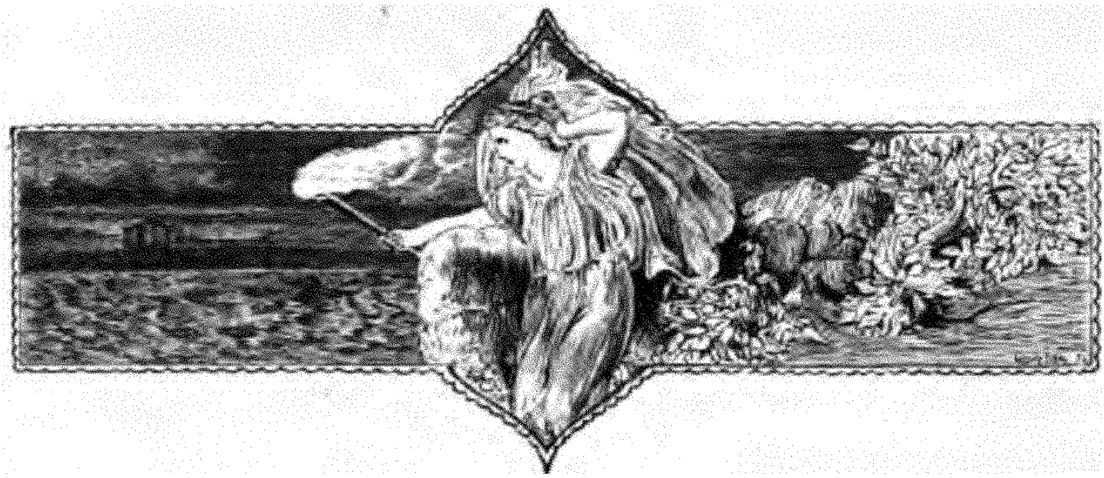
We designate it an "intermittent light" when the ray suddenly appears, remains visible for a moment, and afterwards is again suddenly eclipsed for a brief interval.

With this scientific arrangement before us, it seems strange to recollect that even so lately as the year 1816, the Isle of May light, in the Firth of Forth, consisted of nothing better than a coal-fire. Nor had England made any greater progress in the art of illumination, for the magnificent tower of the Eddystone, says Mr. Stevenson, about fifty years after it came from the hands of Smeaton, could boast of no better light than that derived from a few miserable tallow candles. Nay, so lately as the year 1801, the light at Harwich, in addition to the coal-fires, had a *flat plate* of rough brass on the landward side, to serve as a reflector! Such methods, continues Mr. Stevenson, were most imperfect, not only in point of efficiency and power, but also as respects the distinction of one light from another; an object which, on a difficult and rugged coast, may be considered as of almost equal importance with the distance at which the lights can be seen.*

It must also be remembered that too great a multiplicity of lights would not be less dangerous than a deficiency in number. Were the littoral too abundantly illuminated, the effect produced on the navigator would be that of a continuous and confused line of fire. He would be dazzled

* Stevenson, "On Lighthouses," pp. 60, 61.

by the blaze, and unable to determine the particular point to which he should steer his vessel. Before the Royal Commission of 1861, one witness actually gave it as his opinion that there were too many lights on the English coast, and that the consequence was an increase of collisions, a neglect of the lead, and continual shipwrecks. He added, however, that without the increase of light, steamers could not run in and out of ports at night. The extent of illumination being necessary, the only method of reducing the danger of confusion to a minimum is that adopted by our engineers—a clear and distinct variety of lights.



CHAPTER III.

THE ILLUMINATING APPARATUS OF LIGHTHOUSES.

IT has very justly been said that the object of placing in a lighthouse an illuminating apparatus is, that, whether it be constructed of glass or of metal, it may *bend the rays* (which would otherwise and naturally proceed in straight lines), and illuminate a hollow sphere, so that those rays which would otherwise be thrown upon the sky, and thereby wasted, may be made to fall on points at sea, where they will be clearly visible. If the light is to be a fixed one, intended to be seen all round, and from the horizon to the base of the light-tower, the upper rays issuing from an illuminating apparatus must be directed downwards, and the lower rays upwards, so as to increase the illumination. If it is desired to light up a narrow belt of the sea, extending from the horizon to the base of the lighthouse, all the rays must be bent laterally; or they may all be concentrated and thrown upon one or more spots of larger or smaller size, according as the light may be needed—as in the case of fixed lights placed at the end of narrow channels, and of revolving lights which are made visible all round by causing the lenses and reflectors to revolve about the source of light, or with that source about a centre.*

Two methods have been employed for the purpose of throwing light in the desired direction: first, by silvered parabolic reflectors, which is called the *Catoptric System;* second, by the employment of lenses of a peculiar construction, which is known as the *Dioptric* (or *Refracting*) *System.*

Occasionally these two systems are combined, as in the ordinary *Catadioptric*, and in Mr. Stevenson's admirable *Holophotal* arrangement, whether Catoptric or Dioptric.

Before describing them, however, it will be desirable to offer a brief history of lighthouse illumination.

It was at a comparatively recent epoch that wood and coal fires were for the first time replaced by candles, and the open summit of the tower covered in with glass. About the end of the eighteenth century, for these insufficient producers of light, lamps were substituted, whose lustre was directed to a distance by reflectors of polished metal. Many of the lighthouses of this epoch were provided with the species of apparatus here described; among others, those of Capes de l'Ailly and de la Heve, the isles Rhé and Oleron. In 1782, an identical mode of lightage was established at Cordouan; but though this lighthouse did not include less than twenty-four lamps, accompanied each by a reflector, it diffused so feeble a light, that the seamen immediately insisted on a return to the barbarous system of the Middle Ages.

The apparatus of which they complained was, in truth, exceedingly defective; its lamps, differing but little from

* *Edinburgh Review*, Jan. 1862, pp. 178, 179.

those which the seven foolish virgins suffered to die out, had broad wicks, and if they produced but little light, by way of compensation they emitted an enormous amount of smoke. It was natural, therefore, that men of science should, with a view to improvement, first direct their attention to the *lamp*. The pioneer in this course of inquiry was Argand, who, about 1748, contrived to secure "a double current of air;" which consists, as any one may see in the first lamp he meets with, of a wick, shaped like a hollow cylinder, enclosed in a glass tube. The heat caused by the combustion of the oil produces a vigorous draught, which leads to an abundant circulation of air both internally and externally; and air is for the lamp, as for man, the plant, and the animal—life!

Various modifications and improvements of Argand's system have been successively introduced. The glass tube, for instance, by one inventor, was contracted at a short distance above the burner, so as to project more immediately the current of air upon the flame, and stimulate combustion. In his turn, Carcel bethought himself of supplying the wick with a superabundant quantity of oil, so as to avoid the heating of the burner, and to render the flame more regular; he thus succeeded in keeping the lamps burning for a longer period without a replenishment of the wick.

There then remained the *reflectors*. Curved in the form of a spherical segment, these received but a small portion of the luminous rays, and rarely returned them in the proper direction. Teulère, the engineer-in-chief of the province of Bordeaux, who was to distinguish himself at a later period by the erection of the Cordouan Tower, was ordered to make an examination of both the lamps and the reflectors, and to study the best means of remedying the evils complained of. His studies resulted in a paper of great interest, published in 1783. To concentrate in a single direction a large portion of the rays which were lost on all sides, he proposed the use of mirrors of perfect polish and a better form. By causing these mirrors to revolve around a lamp—that is, by projecting successively towards every point of the horizon the lustre formed by a large portion of the rays thus collected into a single sheaf—he invented at the same time the eclipse.

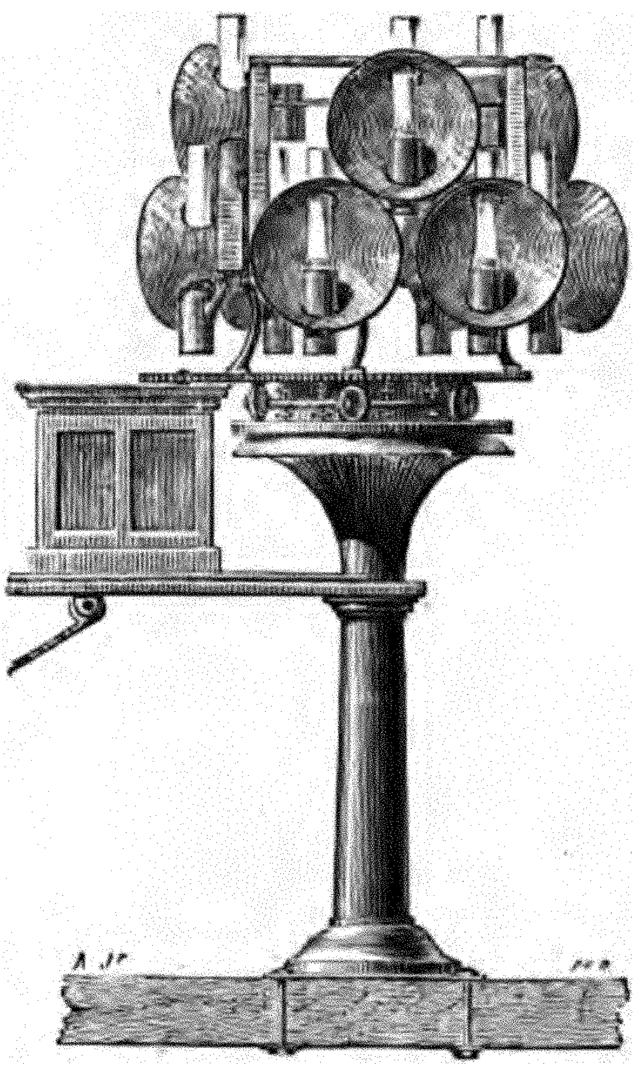
It was not at Cordouan, nevertheless, that the system was first applied, but at Dieppe, where the celebrated Borda, having studied Teulere's paper, had a small revolving apparatus of five parabolic reflectors made * in 1784. The apparatus of Cordouan, likewise established by Borda, was not placed in the lighthouse tower until after its restoration by Teulère—that is, in 1790.

This method of lightage was obviously a great improvement, and all the maritime powers hastened to adopt it. As the *Catoptric System*, it was, until within the last few

* To be more exact than have been the majority of authors who have written on lighthouses, we must add that a small revolving apparatus, with three reverberators (probably with spherical shells), had been planted at the mouth of the port of Marstrand, in Sweden, prior to 1783. The French engineer, however, had thought out the invention for himself, in ignorance that it had been elsewhere realized, and his was the merit of imagining a system so complete and so rational in all its parts, that nothing has since been added to or taken from his conception.

M. Leonel Reynard informs us that we are likewise wrong in attributing to Argand the idea of a lamp with a double current of air. It is to Teulère that it should, in the main, be attributed. However, this engineer, who has asserted the priority of his claim to the invention of the reflectors, and the system of eclipses, has not insisted upon that of the lamp. He limits himself to saying that Argand entertained the same idea as himself, and derived great profit from it.

years, exclusively employed on the coast of England. Though less esteemed in France, its use has not been entirely abandoned; and the French still employ catoptric apparatus for "the illumination of narrow channels, or for harbour-lights; to strengthen in a given direction a light whose range is sufficient for the maritime horizon generally; to illuminate lightships; and for service as provisional appliances."


CATOPTRIC APPARATUS.

In the accompanying design we represent a plan and elevation of a catoptric apparatus, which is composed, as will be seen, of nine reflectors arranged in groups of threes. A small rotatory machine sets the system in motion, and eclipses at greater or shorter intervals are obtained by the varying speed with which it is worked. The range of the apparatus depends partly on its power, and partly on its position.

The reflectors, as usod in the best lighthouses, are made, says Mr. Stevenson,*

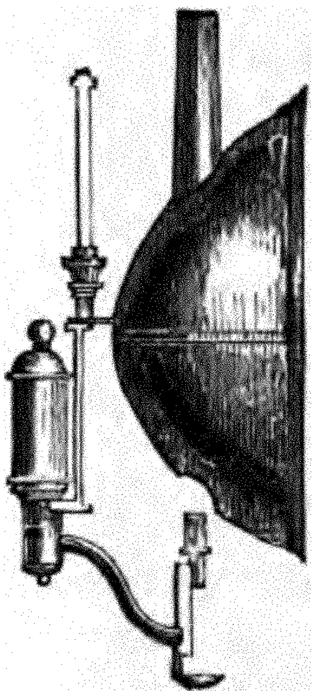
* Stevenson, "On Lighthouses," pp. 92, 93.

of sheet copper, plated in the proportion of six ounces of silver to sixteen ounces of copper. They are moulded to a paraboloidal form by a delicate and laborious process of beating with mallets and hammers of various forms and materials, and are frequently tested during the operation by the application of a mould carefully formed. After being brought to the curve, they are stiffened round the edge by means of a strong bizzle, and a strap of brass which is attached to it for the purpose of preventing any accidental alteration of the figure of the reflector. Polishing powders are then applied, and the instrument receives its latest finish.

To prove the form of the reflector, two gauges of brass are employed. One is for the back, and used by the workmen during the process of hammering; the other —while the mirror undergoes its final touches—is applied to the concave face. The mirror is then tested by trying a burner in the focus, and measuring the intensity of the light at various points of the reflected conical beam.

The flame generally used in reflectors is derived from an Argand lamp, with wicks an inch in diameter. The burners are sometimes tipped with silver to prevent the wick from being wasted by the great heat which is evolved. They are also fitted, in many of the Scottish lighthouses, with a sliding apparatus of accurate shape, by which they can be removed from the interior of the mirror at cleaning time, returned exactly to the same place, and locked by means of a key.

Catoptric lights, we may add, are divided into *nine* separate classes, differing in some respect from those recognized by the French authorities. The nine classes are called *fixed*, *revolving white*, *revolving red and white*, *revolving red with two whites*, *revolving white with two reds*, *flashing*, *intermittent*, *double fixed lights*, *and double revolving white lights.*



AN ARGAND FOUNTAIN LAMP.

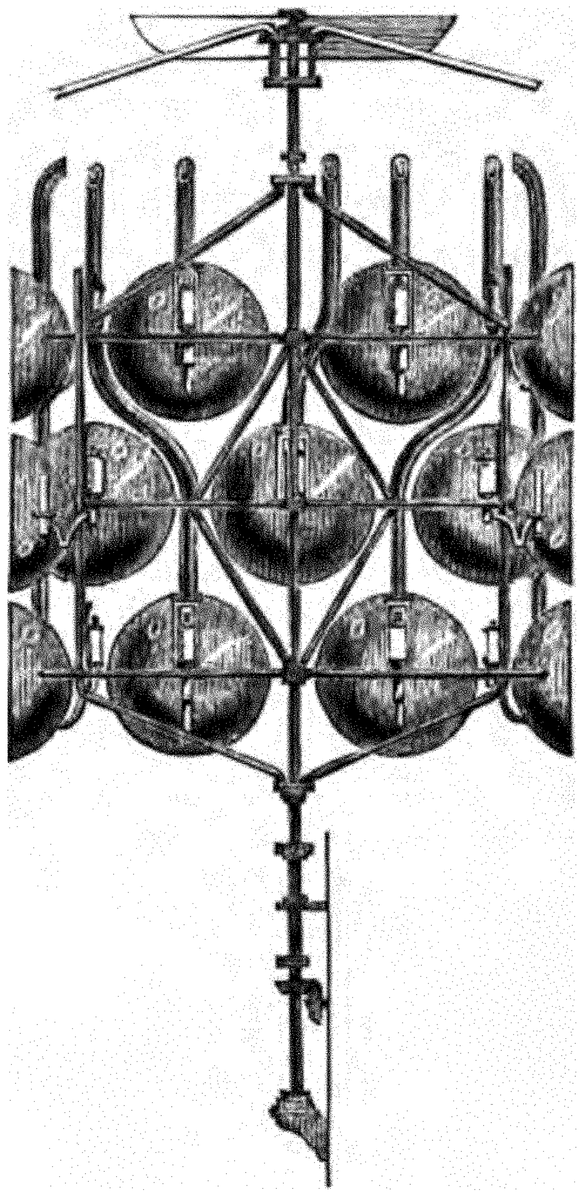
The following account of the distinctive character of each class of light is condensed from a valuable treatise by Mr. Alan Stevenson :—

The *fixed* exhibits a regular and steady appearance, and is not subject to any change; and the reflectors employed are smaller than those required for revolving lights. This is necessary, in order that they may be ranged round the circular frame, with their axes so inclined as to admit of their illuminating every point of the horizon.

The *revolving light* is produced by the revolution of a three or four sided frame, having large reflectors grouped on each side, with their axes parallel; and as the revolution exhibits once a minute, or once in two minutes, a light gradually increasing to the maximum, and then just as gradually decreasing to total darkness, its effect is remarkably impressive.

The *revolving red and white* is obtained by the revolution of a frame whose different sides present red and white lights, and exhibit the following succession :—two white lights after one red, or two red lights after one white.

The *flashing light* is effected in the same manner as the revolving; but, owing to a different construction of the frame, the reflectors on each of the eight sides are arranged with their rims or faces in one vertical plane, and their axes in a line inclined to the perpendicular — a disposition of the mirrors which, together with the greater quickness of the revolution, showing a flash once in five seconds of time, produces an impressive effect, wholly different from that of a revolving light, and presenting the appearance of an alternating rising and sinking illumination.



REVOLVING APPARATUS ON THE CATOPTRIC PRINCIPLE.

The brightest and darkest periods being but momentary, this light is also characterized by a rapid succession of bright flashes; whence its name.

The *intermittent light* is distinguished by bursting suddenly into view and continuing steady for a short time, after which it is suddenly eclipsed for half a minute. This is due to the perpendicular motion of circular shades in front of the reflectors, by which the light is alternately revealed and hidden.

The *double lights* ("which are seldom used except where exists a necessity for a *leading* line, as a guide for taking some channel or avoiding some danger") are generally exhibited from two towers, one of which is higher than the other. At the Calf of Man, says Mr. Stevenson,* a striking variety has been introduced into the character of leading lights, by substituting for two *fixed* lights, two lights which revolve in the same periods, and exhibit their flashes at the same instant; and these lights are, of course, susceptible of the other variety enumerated above, that of the revolving red and white lights, or flashing lights, coming into view at equal intervals of time. The utility of all these distinctions is to be estimated with reference to their property of at once striking the eye of an observer, and being instantaneously obvious to strangers.

The introduction of *colour* as a source of distinction, is the only means of obtaining a sufficient number of varieties. Yet, in itself, it is an evil of no small magnitude. The effect being produced by interposing coloured media between the burner and the eye of the observer, much light is lost by the absorption of those rays which are retained in order to produce the desired appearance. Experiments have been made with almost every colour; but only red, blue, and green have proved useful, and the

* Stevenson, "On Lighthouses," pp. 105–107.

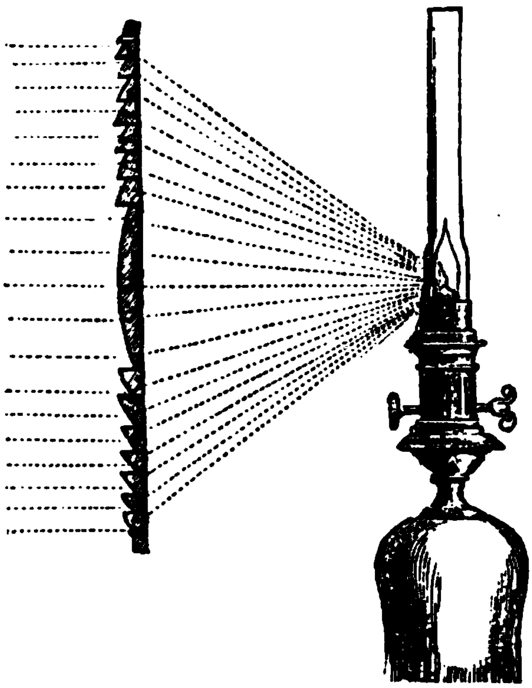
two latter merely at such short distances as to unfit them for "sea-lights." Owing to the depth of tint required to produce a marked effect, the red shades generally absorb about from six-sevenths to five-sevenths of the whole light; a loss so immense as certainly to discourage their adoption whenever it can possibly be avoided. The red glass used in France absorbs only four-sevenths of the light; but then, as might be expected, its colour produces a much less signal distinction to the seaman's eye. In some of the British lighthouses, the lights are very simply and conveniently coloured, by the use of chimneys of red glass, instead of placing large discs in front of the reflectors.

We come now to the *Dioptric* System of Lights.*

The application of lenses to lighthouses seems to have been proposed in England, and essayed at the South Foreland, as far back as 1752; but owing to mechanical imperfection, they were found to give a light inferior to that of the paraboloidal reflectors, and consequently were abandoned. Buffon, the great naturalist, suggested that a lens might be constructed in concentric zones out of a solid piece of glass; but the difficulties of the process have proved too great to be overcome. In, or about 1773, Condorcet proposed that burning lenses should be built up in separate pieces; and a similar method was described by Sir David Brewster in 1811. The same construction was quite independently discovered by the ingenious Fresnel in 1819; and soon afterwards he con-

* From the Greek *δίοπτρον*, an optical instrument with tube for looking through. *Δίοπτρον* is from *δια*, through; and *οπτομαι*, I see.

structed a lens, placed a powerful lamp in its focus, and rendered it available for the practical purposes of a lighthouse. He is therefore the author, if not the inventor, of the highly successful system of illumination which bears his name.



ANNULAR BUILT LENS.

But before entering into a minuter description of the work, let us learn a few particulars of the man.

Jean Augustin Fresnel was born at Broglie, near Bernay, in the French department of the Eure, on the 10th of May 1788. When eight years old the future savant was still ignorant of his letters; a fact, says one of his biographers, to be attributed not so much to his delicate constitution as to a deep-rooted dislike for the study of languages, and, in general, for all exercises dependent upon the memory. But, on the other hand, at nine years of age, he was already distinguished by the experimental researches he had made in the domain of physics; which induced his parents to send him to the Polytechnic School. Here, rising step by step with remarkable rapidity, he eventually became Engineer of Ports et Chaussèes.

In 1819 he carried off the prize proposed by the Academy of Sciences on the difficult question of the diffraction of light. His investigations had long been directed to optical subjects, and hence, when the French Government established the Lighthouse Commission, Arago, who was nominated president, immediately appointed Fresnel to the important post of secretary.

Fresnel recognized the peculiar advantages of a plano-convex lens to refract in lines nearly parallel to their axis all the rays emananting from their foci. Like Condorcet and Brewster, who, as we have seen, had also turned their attention to the problem, though only for so far as concerned burning instruments, he asked himself whether, by arranging the lenses in stages, it was not possible to correct their spherical aberration—a defect which becomes all the more signal as the size of the lenses is enlarged—and, consequently, to obtain full command over the rays of a lamp.

Let us now transport ourselves to the upper story of a lighthouse, and putting aside the motive mechanism of the apparatus, let us penetrate into the lantern. Cast your glance upon the interior of that immense diamond which we call a *dioptric apparatus*. The first object which strikes our attention is the lamp. As the fire which shone on the summit of the edifice was the soul of the pharos, so the lamp is the soul of the modern lighthouse. It was to this lamp Teulere first directed his attention, when he brought the catoptric system to perfection; and it was to this lamp that Arago and Fresnel addressed themselves when engaged, in their time, in improving the work of Teulere, Argand, and Borda. Only, every lighthouse does not employ the same kind of lamp. In one, we meet with the Carcel lamp, where the oil is elevated to the wick by a clock-work mechanism. In another, it is the Moderator, in which the same function is discharged by a heavy weight surrounding a roller. In others, whose range is limited, it is the Permanent-level lamp, where the reservoir of oil is placed by the side and on the level of the burner, which possesses the power of regulating the supply.

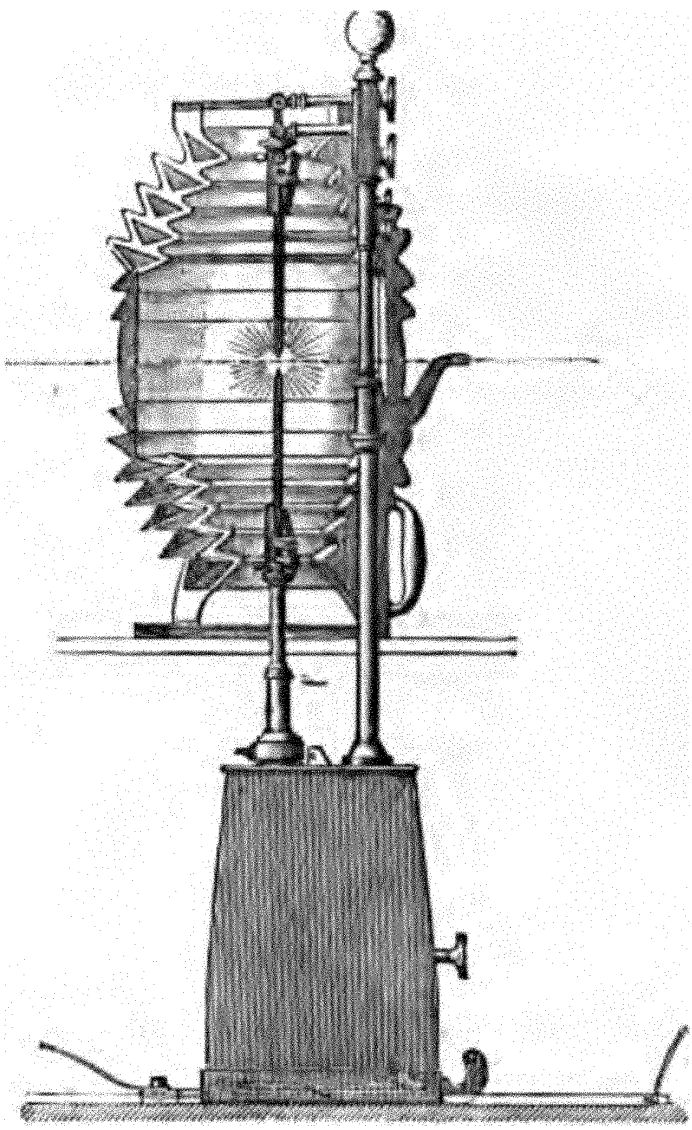
Let us draw near, however, and carefully examine the lamp now before us, because in several details it differs from those we have described. It will specially interest us as an English invention.

At the epoch when Teulere and Argand had made the progress already specified in the construction of a suitable lamp, Rumford, desirous of effecting a still greater improvement, asked himself whether, by adapting it to burners with several concentric wicks, it would not be possible to increase its power of illumination. The attempt was made, but did not prove successful; he experienced considerable difficulty in regulating the flame of these multiple wicks, and in preventing their carbonization under the action of the intense heat developed by their combination. It was the study of this question which led Fresnel and Arago to their beautiful experiments on the illumination of lighthouses.

After repeated essays, these two men of science decided on the type of the lamp which we are now contemplating; an instrument remarkable not only for the whiteness and intensity of its light, but also for what I may call its power of endurance; it will burn for upwards of twelve hours without requiring to be touched. And that this advantage is most important the reader will apprehend, when he remembers that the lighthouse-flame must be kept kindled throughout the longest nights of winter.

At the present day, lighthouses of the third class are illuminated by lamps with two concentric wicks; which, in a certain sense, means two lamps in one. In lighthouses of the second class, each lamp has three; and in those of the first class, each has four wicks. In the latter we obtain, with a single illuminating apparatus, the full power of twenty-three Carcel lamps. The luminous focus, though gifted with so much potency, presents, nevertheless, but a flame of moderate breadth, and its light is as white as it is brilliant.

The oil employed in the lighthouses of Great Britain, Ireland, and France is the colza, which has of late years entirely superseded spermaceti oil, as producing an equal quantity of light at little more than half the expense. The electric light has, however, been proposed as a more powerful method of illumination. One system, in which the light is produced between carbon points by the revolution of magnets fixed on wheels, worked by a steam-engine, was tried with much success by Professor Holmes at the South Foreland; and is still, we believe, in use at Dungeness, as it is, in France, at the two lighthouses of La Heve. In the latter case, the mechanism producing the currents is composed of two steam-engines, each with a five-horse power, and of four electro-magnetic machines of six discs, composed each of sixteen bobbins. It is placed in a boat, adapted for the purpose, at an equal distance from the two towers. Under ordinary atmospheric conditions, a single steam-engine is kept in motion, communicating with a magneto - electric machine for each lighthouse. During fogs and mists, both engines are in activity, and each lighthouse receives the currents of two magneto-electric batteries, which are then associated.



ELECTRIC APPARATUS FOR A FIXED LIGHT.

Both lighthouses are supplied with two lenticular apparatus, placed one above another in the same lantern. The regulators of the progress of the carbons were invented by M Serrin, whose object has been to augment their sensibility, and, consequently, the regularity of the light; in which respect, now-a-days, little is left to be desired. The mean intensity of the light produced by a machine of six discs is computed as equal to 200 Carcel burners. The intensity of the cone of light emanating from the lenticular apparatus, when illuminated in this manner, rises to 5000 burners.

The electric light, as yet, is applied only to lighthouses with fixed lights, for a special arrangement would be necessary in the lenticular apparatus before it could be employed with the same advantage in the production of intermittent lights (*feux a eclipses*). Experiments, however, have been made in this direction, which promise good results. Yet, in the present state of its mechanical conditions, the system of electric illumination does not seem susceptible of any very great development upon our shores. It cannot be applied economically to lights which require no very great intensity,—and these lights are the most numerous; and, on the other hand, the intricate constructions which it necessitates, the chances of accident which it presents, and the quantity of coal which it consumes, are obstacles to its employment in lighthouses isolated at sea, whose communications with the mainland are liable to interruption, and where it is of importance to reduce as much as possible the dimensions of the edifice as well as the amount of transport. However this may be, the electric light would seem destined to render valuable services to navigation at every point where it can be employed, and like the two great inventions which the history of marine lightage signalizes—that of paraboloidal reflectors, and next, that of the lenticular apparatus—it constitutes a special and noteworthy progress, under the threefold aspect of intensity of light, diversity of character, and the value of luminous unity.

We may add that Mr. Wilde, of Manchester, has invented a powerful electro-magnetic apparatus for lighthouse illumination, which may probably prove valuable.

Modifications of the lime light, resulting from the action of an oxy-hydrogen flame upon a surface of prepared lime, have also been suggested; and the least powerful of these surpasses in brilliancy the best oil-lamp, as that surpasses the open coal-fire. We may, therefore, expect that as the latter barbarous mode of illumination gave way to the catoptric, or *reflecting* system, so will the dioptric, before many years have passed, succumb to some ingenious apparatus capable of utilizing either the lime or the electric light.

We now return to Fresnel's system, the *dioptric*, which is pretty generally adopted in the British lighthouses.

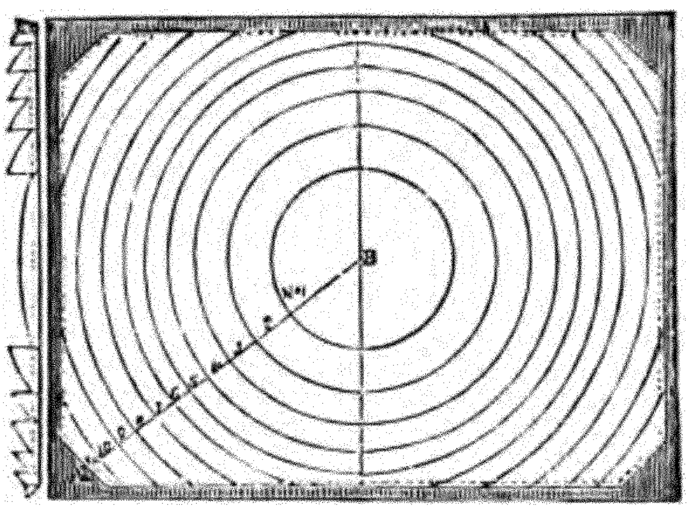
We must here premise that the system is based upon the laws of the refraction of light.

But, says the non-scientific reader, what do you mean by the *refraction* of light? I know very well what reflection is; I am not so clear as to refraction.

A ray of light, when transmitted *obliquely* from one transparent body to another of different density, undergoes, at the point where it strikes the common surface of the two planes, a sudden change of direction. This change of direction is called *refraction.* For instance, plunge one half of a straight ruler into a basin of water. The ruler no longer appears straight, but *bent back* or *broken* (*re*, and *fractum*) at the point where it enters the water.

We have already stated that the great object to be gained in lighthouse illumination is this very *refraction;* that is, the rays of the lamp must be refracted, or bent back, so as to strike and illuminate the sea.

Fresnel saw that this object might be secured by the employment of lenses to intercept, as it were, and refract the rays proceeding from the lamp. What kind of lens possessed the greatest power of refraction? He preferred the plano-convex lenses, which, instead of having two curve surfaces, have one surface a curve, and the other a plane. And the lens thus adopted he built up in separate pieces, for the still greater economization and intensity of light;



ANNULAR LENS OF FIRST ORDER.

and, says Mr. Stevenson, he has subdivided with so much judgment the whole surface of the lens into a centre lens and concentric annular bands, and has so carefully determined the elements of curvature for each, that it seems unlikely any improvement will soon be effected in their construction.

The central disc of the lens, marked B in the accompanying diagram—as employed in lights of the first order—is about 11 inches in diameter, and the focus distance equals 920 millimètres, or 36.22 inches. The annular rings surrounding it gradually decrease in breadth as they recede from the centre, from 2¾ to 1¼ inches. The lens, we should add, is made of crown glass.

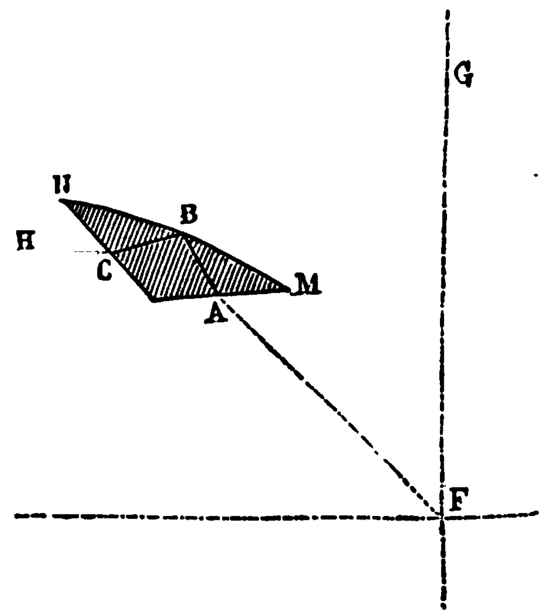
A lens of this magnitude costs about £60. Its weight is about 109 lbs., and its surface consists of about 1300 square inches; but though composed of so many parts, it is held together simply by two narrow strips of polished glass, united by a thin film of cement.

The following illustration, representing a segment of the profile of a dioptric apparatus, will give the reader a sufficient idea of the manner in which the rays proceeding from the focus of a lamp are refracted on issuing from the lens; it also shows the central disc, and the rings placed above and below it.

When the drum is circular instead of being polygonal, the lenses are cylindrical and not annular; the luminous rays are uniformly distributed in the horizontal plane, and act—in a meridian section—in the same manner as those of the annular lenses.

Yet there is something more than lenses in a dioptric apparatus, for this reason, that the lamp does something more than illuminate the frame. The rays streaming below it vainly poured their light at the foot of the tower, and those which rose above it were diffused in the upper region of the atmosphere, and consequently, for all purposes of marine illumination, would have been useless, had not Fresnel conceived the idea of collecting, concentrating, and despatching them in the same direction as the lenses threw the others. This he effected by means of the cylindrical rings of glass which, above and beneath the lenses, cover over the framework, as it were, or make use of it as a base, in expanding themselves as they approach the centre of the apparatus.

The subjoined illustration represents the progress of a luminous ray in one of the rings of glass, technically termed *catadioptric rings.* Issuing from the focus F at the summit of the angle formed by the lines G and I, it is refracted at A in the direction A B, undergoes a complete reflection on the surface M N, takes the direction B C, and finally emerges from the ring in the horizontal line C H.



DIAGRAM, ILLUSTRATING THE PROGRESS OF A LUMINOUS RAY IN A CATADIOPTRIC RING.

At this solution of the difficulty Fresnel did not arrive all at once, owing to the absolute want of workmen suitable for carrying out the novel industry which his genius had created. But by degrees these were trained and perfected; and the inventor had, moreover, the good fortune of discovering in an able and ingenious optician, M. Soleil, an efficient assistant in the construction on a large scale of the novel instrument he required. Afterwards the erection of lighthouses becoming an important branch of industry, he completed several edifices, which prospered all the more that strangers immediately gave up any attempt at rivalry, and left to him the work of supplying every maritime nation with lenticular apparatus.

Having said thus much of the central lens and its concentric rings of glass, a few words become necessary in reference to the lamp which feeds them, as it were, with light. Fresnel's lamp may be shortly described as containing four concentric burners, which are defended from the excessive heat produced by their own combined flames by a superabundant supply of oil. This oil is pumped up from a cistern below by means of a clockwork movement, and overflows the wicks incessantly. To supply fresh currents of air to each wick with a rapidity sufficient to support the combustion, a very tall chimney-tube is found requisite. And yet the wicks do not carbonize with the extreme speed that might be supposed. It is even found, we are told, that after they have suffered a good deal, the flame does not perceptibly decrease, because the intense heat evolved from its mass encourages the rising of the oil in the cotton. Mr. Stevenson informs us that he has seen the large lamp in the Tour de Corduan burn for seven hours, and yet the wicks were neither snuffed nor raised. In the Scotch lighthouses a full flame is often maintained, with Colza oil, for no less a period than seventeen hours, and yet the lamp is untouched.

The only risk in using the Fresnel lamp, says Mr. Stevenson, arises from the liability to occasional derangement of the leathern valves that force up the oil by means of clockwork. Several lights on the French coast, and, more especially, the Tour de Corduan, have been extinguished by the failure of the lamp for a few minutes; an accident which has never happened, and scarcely *can* happen, with the fountain lamps of the Catoptric system. To prevent such dangerous mishaps, which, under some circumstances, might entail the loss of a "tall ship," various precautions have been adopted. The most efficacious seems to be this: an alarum is attached to the lamp, consisting of a small cup pierced in the bottom, which receives a portion of the oil overflowing from the wicks, and is capable, when full, of balancing a weight placed at the opposite end of a lever. The moment the machinery stops, the cup ceases to receive the supply of oil, and the remainder escaping at the bottom, the equilibrium of the lever is destroyed; it falls, and disengages a spring, which rings a bell with sufficient force to arouse a sleeping keeper. But, says Mr. Stevenson, shrewdly, it may justly be doubted whether such an arrangement might not actually tempt a keeper to relax in his vigilance, and rely on the alarum to waken him in case of need. In all the dioptric lamps on the British coast, therefore, the converse method is adopted of causing the bell to cease when the clockwork stops.

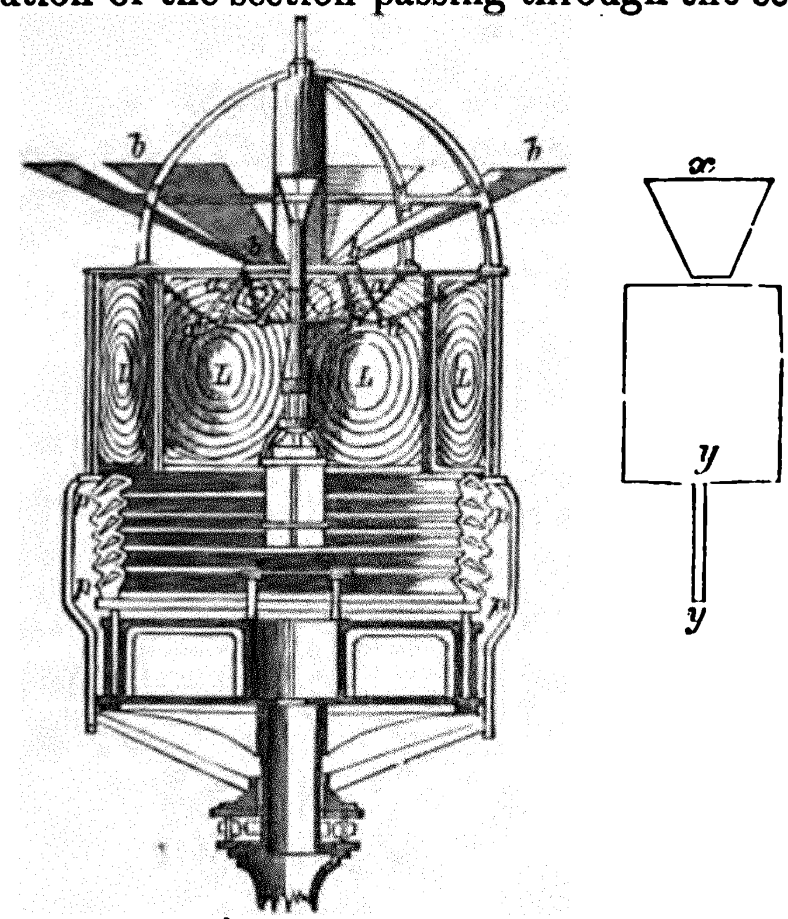
Another and more important precaution consists in keeping always at hand, in the light-room, a *spare lamp*, trimmed, and adjusted to the proper height for the focus, and in every respect ready to act as a substitute for the other if any accident occurs.

But while I am tracing these words, I read that experiments have been successfully made with *gas* for the illumination of the lenticular apparatus, and that, if it will afford a steadier and fuller light, at less expense, and with no risk of accident, it will probably be adopted.

To continue:—

Once having acquired a full command of all the rays amplified from the lamp, the next desideratum was to diversify the appearance of the light which they constituted; for, as I have already said, it is not enough to stretch a belt of warning fires around the coast,—we must take care that each shall in some wise be distinguished from the other, so as to afford the navigator a clue to its particular locality. Hence arose the division into fixed, revolving, intermittent lights, and so on, which I have already described, and which is secured in the following manner:—

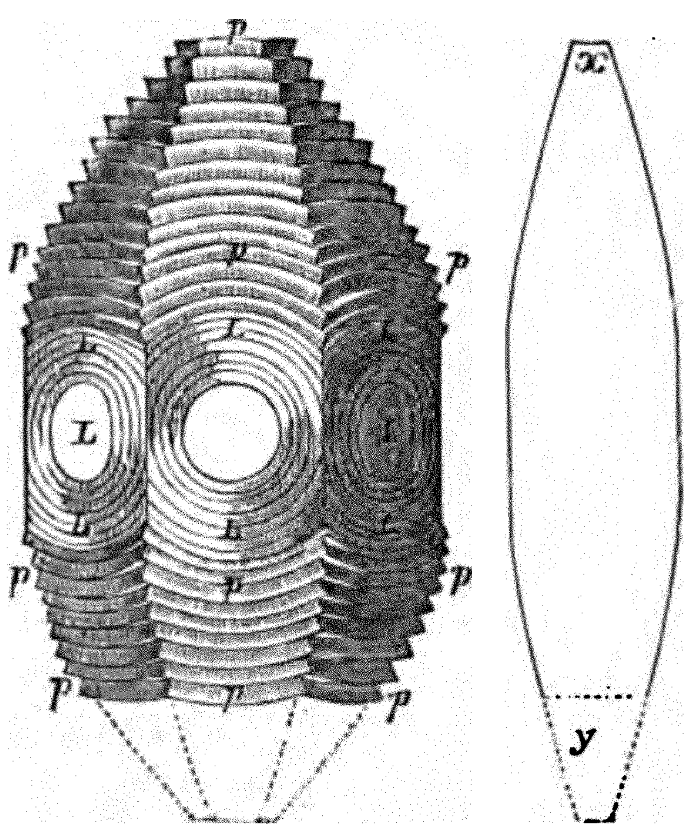
If a *fixed light* be required, the apparatus as invented by Fresnel takes the form of an annular glass frame produced by the revolution of the section passing through the centre



FRESNEL'S REVOLVING LIGHT.

of a circular lens, and reflecting prisms around a vertical elevated on the principal axis of this section, as shown in the diagram.

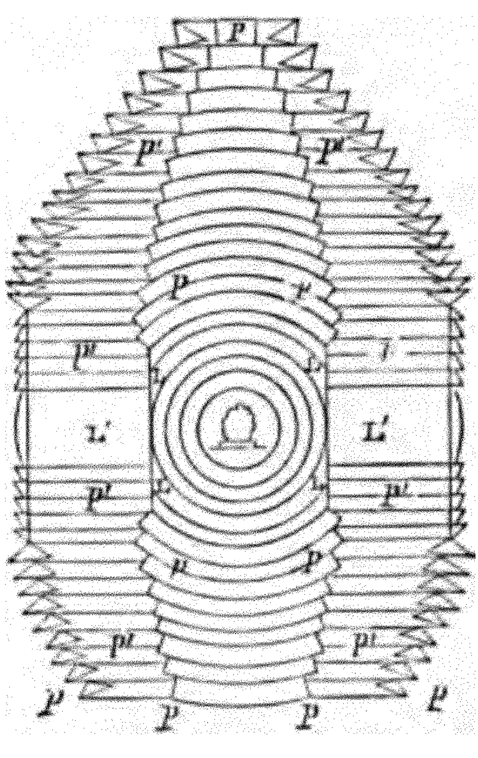
For *revolving apparatus*, Fresnel's apparatus, as employed in all lighthouses prior to the introduction of the holophotal arrangement, consisted, as may be seen in the diagram, of annular lenses, *L*, for acting on the central part of the light, while the upper rays were refracted by inclined hanging lenses, *a*, and ultimately reflected into the proper direction by silvered mirrors marked *b*, placed above. The lower rays were intercepted by fixed light prisms, *p p* (*which did not revolve*), and which, showing a fixed light all round, were, of course, of very inferior power to the solid beams proceeding from the large lenses *L*, and the smaller lenses and mirrors placed above. Strictly speaking, Fresnel's revolving light consisted of a *revolving* and a weak *fixed* light. As the frame revolved round the central lamp, the mariner saw the luminous beam when the lenses were turned towards him and the number of flashes depended on the quickness of the rotation.



STEVENSON'S HOLOPHOTAL REVOLVING LIGHT.

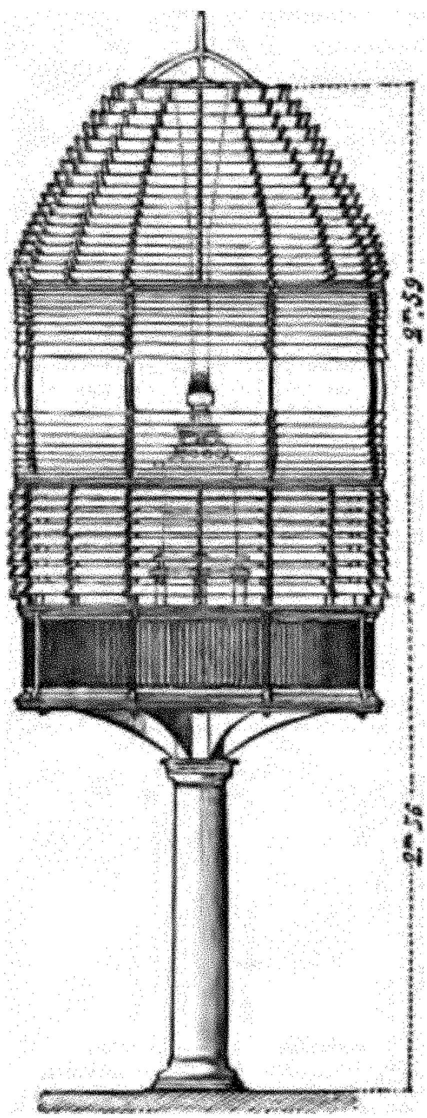
The apparatus adopted by Fresnel for the *fixed* light may be regarded as perfect, but his *revolving* light has been now superseded by the holophotal apparatus of Mr Thomas Stevenson The inclined mirrors and lenses employed in

Fresnel's apparatus are done away with in Mr. Stevenson's. shown in the diagram, in which, by the single agency of lenses, *L*, and totally reflecting prisms, *p*, all the rays are rendered parallel. In this form the *whole* glass frame, consisting of lenses and reflecting prisms, revolves round the central lamp. As Fresnel's lighthouse prisms only gathered the light vertically, they could not produce the sheaf of rays required for the revolving light unless when combined with others which gathered the rays horizontally. The first lighthouse in which single prisms were made to revolve was the Horsburgh light, near Singapore, the apparatus of which was designed by Mr. Stevenson in 1850. In this form of revolving light apparatus the prisms are generated about a horizontal instead of a vertical axis, as in fixed light. The forms of the beams of light issuing forth from Fresnel and Stevenson's apparatus are shown opposite to the diagram of each, and marked *x*, *y*.

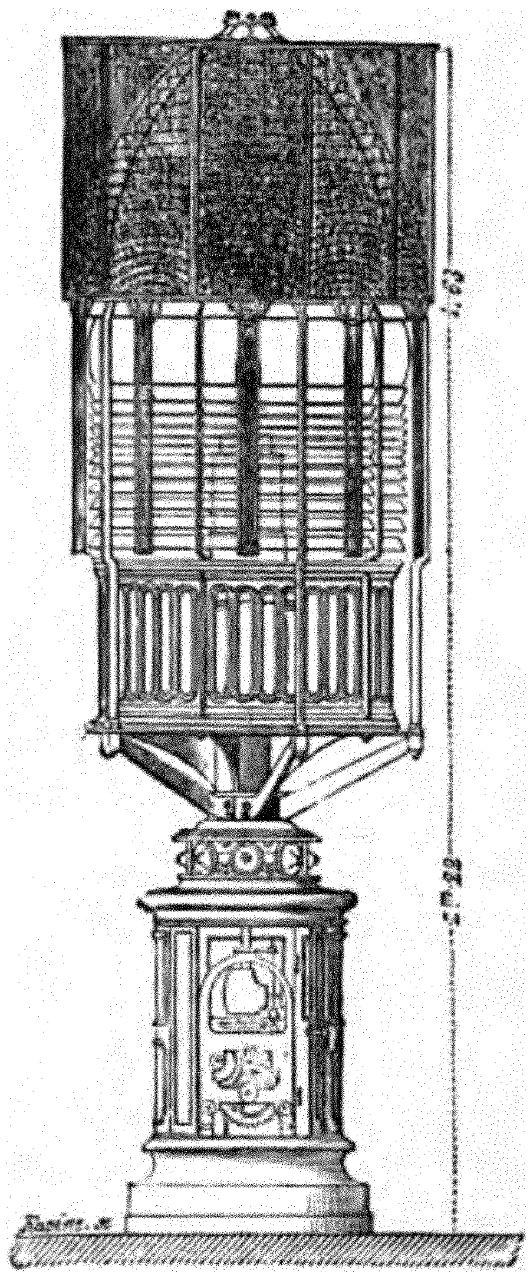


STEVENSON'S FIXED LIGHT VARIED BY FLASHES.

In France there is frequently employed what Fresnel called a "*fixed light varied by flashes.*" This effect is produced, as already explained, by causing panels of glass, curved horizontally but not vertically, to revolve outside of Fresnel's fixed apparatus, as shown in the diagram. The ordinary fixed apparatus only acts in the vertical plane, while the straight panels only act in the horizontal plane. So that when the fixed apparatus is alone visible the rays are only gathered from the vertical plane, and the light is comparatively weak; but when the panels come



FRESNEL'S FIXED LIGHT APPARATUS.



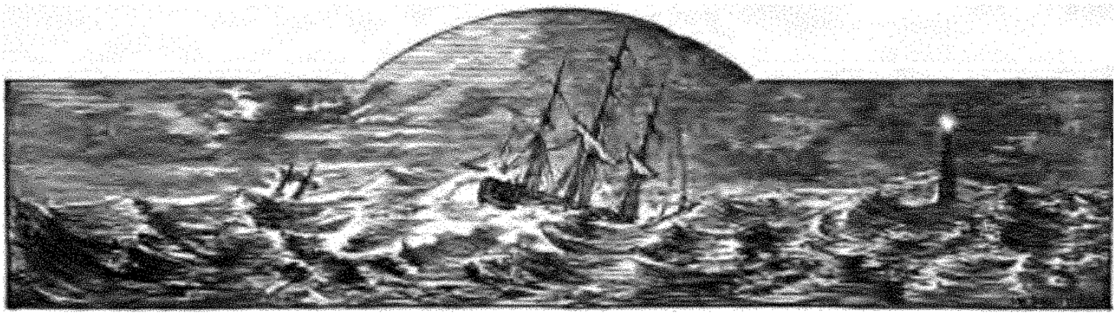
FRENCH FORM OF APPARATUS FOR A FIXED LIGHT VARIED BY FLASHES.

opposite the eye, the rays are gathered from both planes into one powerful beam, as in a revolving light. Here, as in the former case, two agents are employed, causing great loss of light and great unnecessary expense, where one, if of the proper form, is sufficient. Mr. Stevenson's modification of the holophotal arrangement for this purpose is shown in the diagram. It consists of alternate panels of the fixed light and holophotal apparatus; and thus, by single agency, a weak fixed light and a stronger revolving light are shown time-about to the mariner, which is the required characteristic.

If, for the sake of further diversity, the lights are to be coloured, we content ourselves in the case of a fixed light, as already stated, with enclosing the flame in a green or red tube. In the French eclipsing apparatus, polished sheets of coloured glass are placed, on one side or the other, against the lenses intended to emit the flashes of colour.

While doing all honour to Fresnel and his great invention, we must not forget that its present comparative perfection is due to Mr. Thomas Stevenson, whose improvements, in truth, have eventuated in almost a new system, now known as the *Holophotal*,* and already partially described. By a peculiar combination of dioptric spherical mirrors and other apparatus, it also succeeds in economizing and condensing into one beam the whole of the rays thrown off from the burners; but I fear that any explanation of it which could here be attempted would, from its necessary introduction of technical language, prove unintelligible to the non-scientific reader.

* From ὅλος, entire; and φῶς, light.



CHAPTER IV.

THE INTERIOR OF A LIGHTHOUSE.

AFTER having devoted so many pages to what we have called—perhaps somewhat fancifully—the *soul* of the lighthouse, it becomes necessary to say a few words in reference to the *body* which encases it.

In building up this body, no less ingenuity and science have been displayed than in perfecting and expanding the light which gives it life and value. Whether the lighthouse-tower is situated on some wave-washed rock surrounded by a hungry sea, or on the summit of a conspicuous headland, the highest skill is exercised upon its construction, and it becomes, in many instances, a monument of the most brilliant architectural genius. Not, indeed, that it exhibits those beautiful features of clustered columns and lofty arches, or that elaboration of picturesque ornament, which delight us in the lordly mansion and the ancient cathedral; but that an equal perfection of art is revealed in its massive simplicity and impregnable solidity, and in its admirable adaptation to the grand purposes for which it is intended.

Two primary conditions, it is obvious, must always govern the construction of a lighthouse: it must be raised to an elevation suitable for the full display of its warning radiance, and it must be built with a strength and solidity which will defy the assault of wind or wave.

So far as the first condition is concerned, the proper height of a lighthouse-tower is easily ascertained, when the distance is determined at which its rays should be visible. This distance will necessarily depend on the character of the neighbouring seas, and the nature of the reef, rock, or shallow from which the lighthouse is to warn the navigator; but, once determined, the elevation of the tower will easily be calculated by means of the known relations existing between the form of the earth, the effects of atmospheric refraction, and the proper height of an object which is to be seen from a given distance. The state of the atmosphere at any particular point is also an important point of consideration. It is quite possible that the lighthouse, when erected at what seems a suitable elevation, may be rendered useless by a prevalence at that elevation of dense mists and heavy fogs. In 1785, the Trinity Board commenced the erection of a lighthouse on the summit of St. Catherine's Down, in the Isle of Wight, and from so lofty an altitude it might well be supposed that its radiance would illuminate the Channel for leagues around. But, unfortunately, the crest of St. Catherine's is, for the greater part of the year, enveloped in cloud and mist, which effectually prevents the escape of a single ray of light; and, consequently, the Trinity Board were compelled to abandon their design.

The shell of the building still crowns the bleak summit of the down, as a warning to future lighthouse-builders.

Still more recently, the lighthouse on the Needles Down (also in the Isle of Wight), which for years had pointed out the dangerous character of the western entrance to the Solent, has been abandoned on account of the mists so frequently obscuring its lustre; and a new lighthouse has been erected on the outermost of the celebrated Needle Rocks, in a position of far greater utility.

The question regarding the *interior* accommodation of the tower must, in like manner, be answered by the nature of the locality where it is erected. Where it is easily accessible, and its stores can be replenished with ease at very short intervals, obviously the interior accommodation may be reduced within very narrow limits. But in exposed situations, as, for instance, on an isolated rock, whose communication with the mainland may be cut off for weeks at a time, room must be provided for ample supplies, and conveniences for the keepers must be arranged on a liberal scale. In the long and dreary nights of winter, where, in the northern parts of Great Britain, it is necessary to keep the light burning for about seventeen hours, not even for a moment is it left without the watchful care of at least one keeper; and thus, as he will require an interval of repose, its superintendence will occupy *two* persons; but in open, exposed places like the Eddystone, the Bell Rock, the Wolf, and the Skerryvore, where it is frequently impossible to communicate with the mainland for three, four, and even six weeks, circumstances have rendered it desirable that there should not be fewer than three men on duty. Hence, sleeping apartments have to be provided, as well as receptacles for sufficient supplies of water, food, fuel, and other matters.

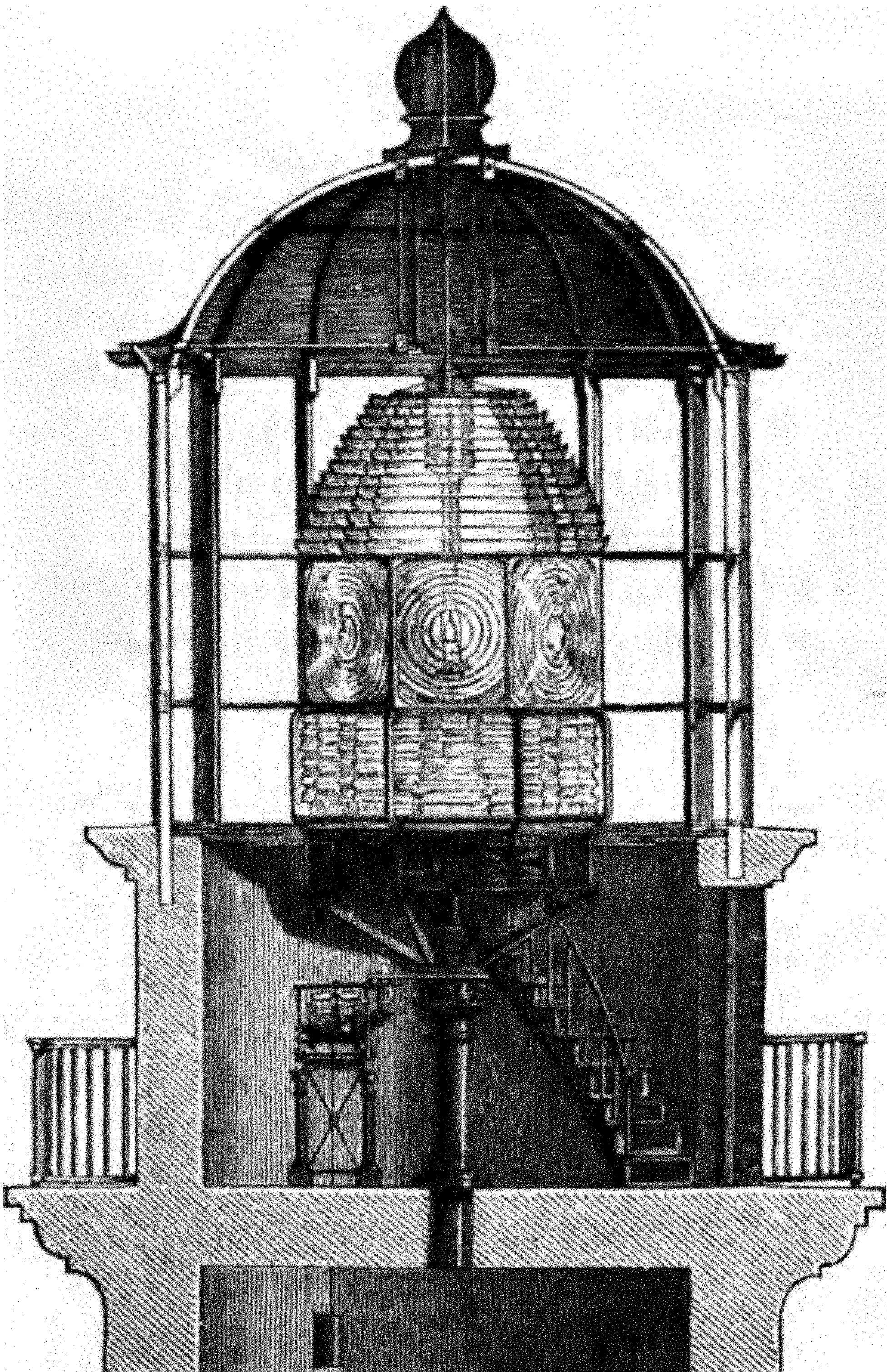
The second condition to which we have adverted is, that the building shall be capable of resisting the force of the wind and waves. The wind is baffled with comparative ease, but the sea is a far more formidable, and, moreover, is an ever-present foe. Even in the summer months the pressure of the waves is very considerable, averaging, perhaps, about 611 lbs. per square foot of surface exposed to it. In the winter, however, the average rises to 2086 lbs. per square foot; while, during stormy weather, the force has amounted to no less than 4335 lbs.* To oppose this immense pressure, not only must the masonry be of the solidest description, but such a form must be given to the building as will expose that masonry to the least possible stress. From various experiments it has been found that the most effective form is that of the cylinder; and with certain modifications, the cylindrical is now almost universally adopted in the erection of lighthouses. Scientifically speaking, however, it is not so much a cylinder as the union of frustra of different cones, with a curve osculating the outline of the successive frustra. To the youthful reader this may not be very intelligible, and we will, therefore, refer him to the form of the Eddystone as an illustration of what we mean. Smeaton himself relates that it was suggested to him by the trunk of an oak, but there seems reason to

* These figures are the results of experiments made with an instrument invented by Mr. Thomas Stevenson, and called the Marine Dynamometer.

believe that this was an after-thought, intended for the benefit of the large class of minds which cannot appreciate scientific reasonings.

Let us now pass into the interior of a lighthouse, and take notice of its general arrangements.

And, first, observe the massive door of bronze which opens to admit us into the lowermost story. Here are collected the stores of wood, cordage, oil, and water; and here too is placed the carpenter's shop. On the next story we find the kitchen and the dining-room. Then we ascend to the sleeping-rooms of the three keepers; they are exquisitely neat and clean, but in other respects do not call for notice. On the highest story we enter that portion of the structure more particularly destined for the special service of the tower. It contains numerous vessels of oil, lenses, lamps, a thermometer, a barometer, and a chronometer. The spiral staircase by which we have hitherto ascended terminates at this point, and to reach the lantern we must climb a ladder before us. Entering the cupola, which enshrines the magic light, we are surprised by its exquisite propriety of arrangement. The form of the lantern is light and graceful; and to avoid the necessity of painting it, the framework is made of gun metal, and the dome of copper. A lantern for a light of the first order is twelve feet in diameter, and its glass frames are two feet high. The glazing is thick, and great care is exercised in fixing it that the plates may not be broken during high winds. Panes glazed in frames padded with cushions, and capable of being temporarily fixed in a few minutes, are always kept ready for use in Scotland. These are called *storm-panes.* The total cost of a lantern such as we have been describing is about £1260.



CUPOLA OF A LIGHTHOUSE OF THE FIRST CLASS.

To secure a good and efficient light it is necessary that the lantern should be well ventilated. Otherwise its sides will be continually covered by the water of condensation produced by the contact of the ascending current of heated air, and the glass, thus obscured, impedes the passage of the rays and diminishes their power. To prevent such an evil an excellent system of mechanical ventilation was devised by the late Professor Faraday.

The ventilating pipe or chimney is a copper tube four inches in diameter, divided into three or four lengths; the lower end of each for about an inch and a half being opened out into a conical form, about five inches and a half in diameter at the lowest part. When the chimney is put together, the upper end of the bottom piece is inserted about half an inch into the cone of the next piece above, and fixed there by three ties or pins, so that the two pieces are firmly held together; but there is still plenty of airway or entrance into the chimney between them. The same arrangement holds good with each succeeding piece. When the ventilating chimney is fixed in its place, it is so adjusted that the lamp chimney enters about half an inch into the lower cone, and the top of the ventilating chimney into the cowl or head of the lantern.

With this arrangement (I use the Professor's own words) it is found that the action of the ventilating flue is to carry up every portion of the products of combustion into the cowl; none passes by the cone apertures out of the flue into the air by the lantern, but a portion of the air passes from the lantern by these apertures into the flue, and so the lantern itself is in some degree ventilated.

The important use of these cone apertures is, that when a sudden gust or eddy of wind strikes into the cowl of the lantern, it should not have any effect in disturbing or altering the flame. It is found that the wind may blow suddenly in at the cowl, and the effect never reaches the lamp. The upper, or the second, or the third, or even the fourth portion of the ventilating flue might be entirely closed, yet without influencing the flame. The cone junctions in no way interfere with the tube in carrying up all the products of combustion; but if any downward current occurs, they dispose of the whole of it into the room without ever affecting the lamp. The ventilating flue is, in fact, a tube which, as regards the lamp, can carry everything *up* but conveys nothing *down*.

The British lighthouses, as I have stated, are under the charge of either two or three keepers, whose duties are to cleanse and prepare the apparatus for nocturnal illumination, and to mount guard alternately after the light is exhibited. The rule is, that under no circumstance shall the keeper on duty leave the light-room until relieved by his comrade; and that no pretence may exist for disobeying this all-important regulation, the dwelling-houses are invariably built in immediate proximity to the light-tower, and means are provided for signaling directly from the light-room to the sleeping apartments below.

For greater security in all such exposed situations as the Eddystone or the Bell Rock, *four* keepers are provided for one light-room. One of these is always ashore, on leave, with his family, and the other three are on guard in the lighthouse, so that, in the case of the illness of one light-keeper, an efficient establishment of two keepers for watching the light may remain.

The following interesting details we borrow verbatim from Mr. Alan Stevenson:*—

Each of the two (or three) light-keepers has a house for himself and family, both being under a common roof, but entering by separate doors. The principal keeper's house consists of six rooms, two of which are at the disposal of the visiting officers of the Board, whose duty in inspecting the lighthouse or superintending repairs may call them to the station; and the assistant has four rooms, one of which is used as a barrack-room for the workmen who, under the direction of the foreman of the light-room works, execute the annual repairs of the apparatus.

The greatest care must be bestowed on securing the utmost cleanliness in every detail connected with a lighthouse, whose optical apparatus is peculiarly sensitive to the effect of dust. For this purpose covered ash-pits are provided at all the dwelling-houses, in order that the refuse of the fireplaces may not be carried on "the wings of the wind" to the light-room; and, for similar reasons, iron floors are used in the light-rooms instead of stone, which is often liable to abrasion, and all the stonework near the lantern is regularly painted in oil.

If, in all that belongs to a lighthouse, the greatest cleanliness is desirable, it is in a still higher degree necessary in every part of the light-room apparatus, without which the optical instruments and the machinery will neither last long nor work well. Every part of the apparatus, whether lenses or reflectors, should be carefully freed from dust before being either washed or burnished;

* Alan Stevenson, "On Lighthouses," Weale's Series, pp. 169, 170.

and without such a precaution the cleansing process would only serve to scratch them.

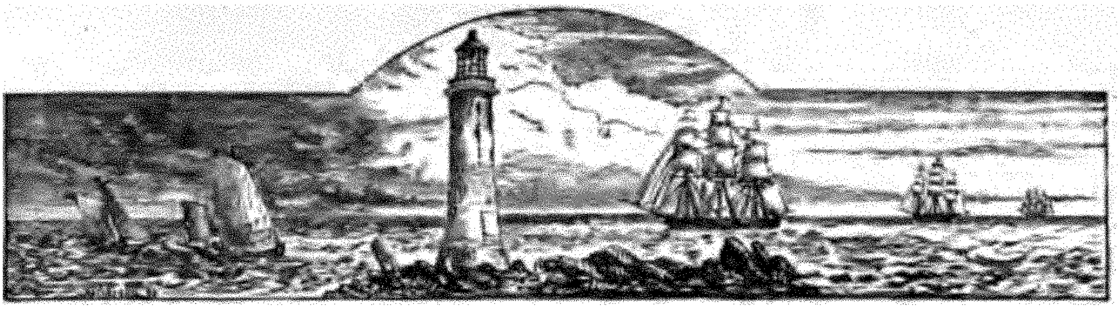
For burnishing the reflectors, prepared *rouge* (tritoxide of iron) of the finest description, which should be prepared in the state of an impalpable powder of a deep orange-red colour, is applied by means of soft chamois skins, as occasion may require; but the great art of keeping reflectors clean consists in the daily patient and skilful application of manual labour in rubbing the surface of the instrument with a perfectly dry, soft, and clean skin, without rouge. The form of the hollow paraboloid is such that some practice is necessary in order to acquire a free movement of the hand in rubbing reflectors; and its attainment forms one of the principal lessons in the course of the preliminary instruction to which candidates for the situation of a lighthouse-keeper are subjected. For cleansing the lenses and glass-mirrors spirit of wine is used. Having washed the surface of the instrument with a linen cloth steeped in spirit of wine, it is carefully dried with a soft and dry linen rubber, and finally rubbed with a fine chamois skin free from any dust, which would injure the polish of the glass, as well as from grease. It is sometimes necessary to use a little fine rouge with a chamois skin for restoring any deficiency of polish which may occur from time to time; but in a well-managed lighthouse this application will seldom, if ever, be required.

Before we quit this subject, it may interest the reader to be informed that the glass of the lantern is frequently broken, not by wind and wave, but by the sea-birds which dash violently against it. In a single night at

SEA-BIRDS ATTRACTED BY THE RAYS OF A LIGHTHOUSE.

Cape de Bréhat nine panes were shattered from this cause. At the lighthouse of Brehat a wild duck forced its way through two rows of mirrors and fell upon the lamp. A thousand of these birds were on one occasion caught by the crew of a British lightship, who made them into a gigantic pie. It is necessary to defend with trellis-work the lights most exposed to visits of this kind.

Fortunately, all sea-birds are not so dangerous. Some of them even render to the navigator a service like that which the goose of the capitol, according to Livy, once rendered to the Romans. At the South Stock lighthouse, near Holyhead, which is situated in the middle of an islet, tamed sea-birds are made use of as signals. The gulls perch on the lighthouse walls and utter loud cries, which wave off approaching seamen. This lighthouse possesses a bell and a cannon, but the natural signal has been esteemed so superior that the cannon has been removed to a distance from the rock, lest its discharge should alarm the birds. The young gulls roam about the island among the white rabbits, living in perfect harmony with them, and providing the keepers with society; a pleasanter society than that of the wind and waves which incessantly vent their fury on the solitary pharos.



BOOK III.

LIGHTHOUSES OF GREAT BRITAIN.

CHAPTER I.

THE STORY OF THE EDDYSTONE: A.D. 1696, 1706, 1759.

THE first lighthouse of a regular character erected on the shores of England seems to have been that of Lowestoft, in 1609. Among its successors we may refer to those of Hunstanton Point, 1665, and of the Scilly Islands, 1680. To the same epoch belong the lighthouses of Dungeness, Orfordness, and the Eddystone; the latter being the most important, the most remarkable, and the most interesting, as, I think, the following brief narrative will not fail to show.

The *Eddystone* is the name of the highest summit of a reef of rocks which lie in deep water about fourteen miles to the south-west of Plymouth harbour. As they are in a line with Lizard Head, in Cornwall, and Start Point, in

Devonshire, they are not only in the track of vessels bound for the great Devonian seaport, but of vessels coasting up and down the English Channel. At high water they are barely visible, and their position could only be told by the waves which *eddy* and seethe above them; at low water several low, broken, and dismal-looking ridges of gneiss become conspicuous. When the wind blows from the south-west, they are the centre of "a hell of waters," and no ship involved in the vortex could hope to escape destruction.

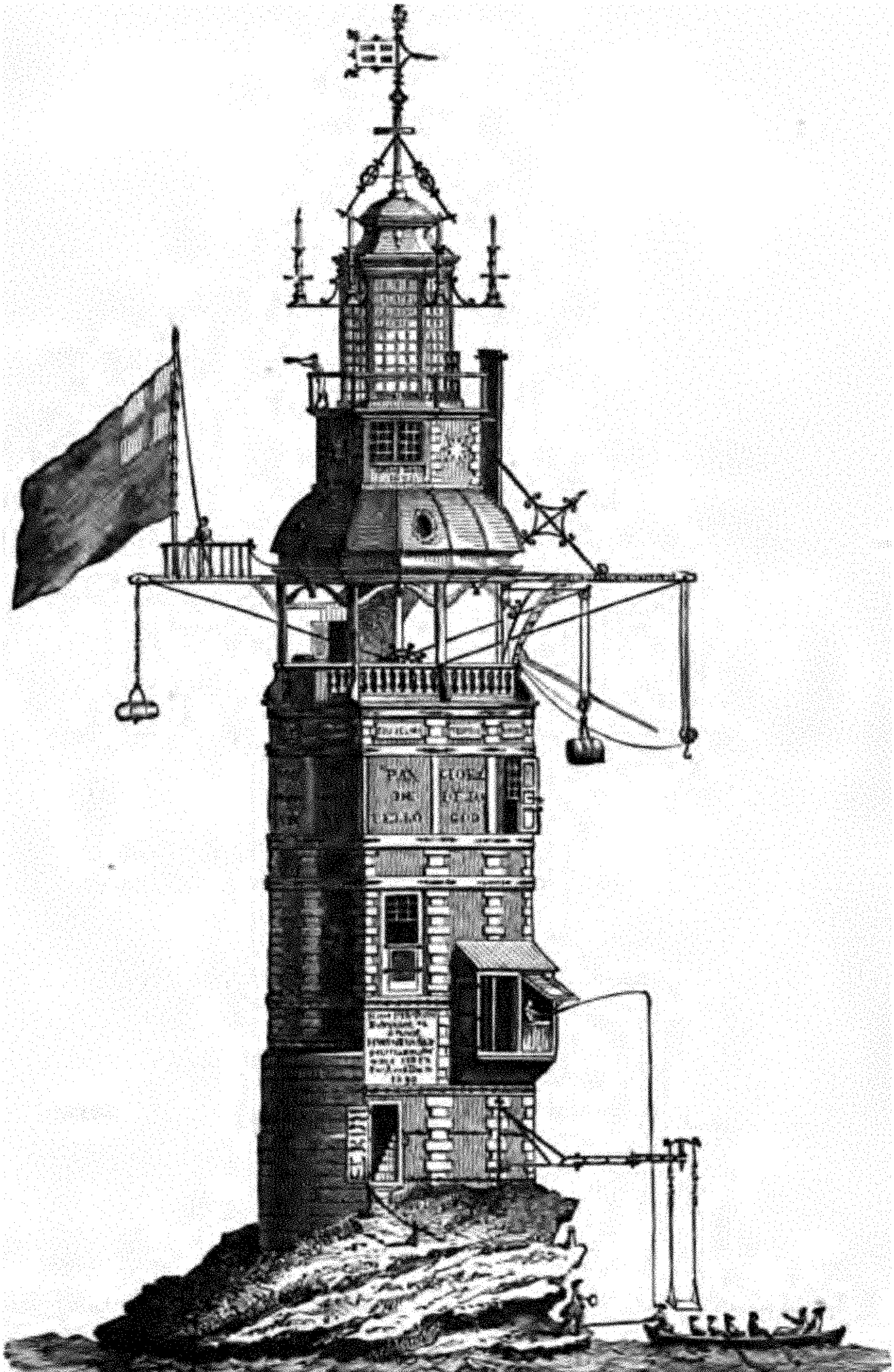
It may readily be conceived that so perilous a reef, when unprotected by any beacon, was a source of deep alarm to the mariner, who, to give it the widest possible berth, was accustomed to enter the Channel in a much more southerly latitude than is now done. But in avoiding Scylla he often fell into Charybdis, and hence the numerous wrecks which occurred on the French coast, and more particularly upon the dangerous rocks surrounding the islands of Jersey, Guernsey, and Alderney.

The erection of a lighthouse upon the Eddystone was, therefore, a matter of national concern; yet no one could be found to undertake a task whose accomplishment nature seemed to have rendered impossible, until Henry Winstanley, a country gentleman of Littleberry, in Essex, chivalrously came forward in the year 1696, and having obtained the necessary legal powers, proceeded to carry his design into execution. This same Winstanley was one of those eccentric geniuses who find a pleasure in mystifying their friends, and in investing their daily life with an air of legerdemain. He adapted science to practical jokes with an ingenuity which, we think, has never been surpassed. If a guest in his bedroom kicked an old slipper out of his way, immediately a ghost started from the floor. If, in another, he threw himself into a chair, it suddenly flung out its two arms, and held him fast as a prisoner. Or if in the garden he retired into an arbour, and rested on a particular seat, he was straightway set afloat in the middle of the adjoining canal.

To the native eccentricity of the man, it has been justly remarked, may be ascribed the fantastical character of the first Eddystone Lighthouse. Its erection was begun in 1696. The first summer—and it was only in summer the work could be carried on—was occupied in making twelve holes in the rock, and fastening as many irons in them, to serve as the superstructure.* The task progressed but slowly, for, as Winstanley himself relates, though it was summer, the weather would at times prove of such terrible violence, that for ten or fourteen days together the sea would so rage about the rocks—agitated by out-winds and the inrush of the ground-swell from the main ocean—as to mount and leap upwards some two hundred feet, completely burying the works, and preventing all approach to them.

The second summer was spent in constructing a solid round pillar twelve feet high and fourteen feet in diameter. In the third year the pillar was enlarged two feet at the base, and the edifice carried up to a height of sixty feet. "Being all finished," says the engineer, "with the lantern, and all the rooms that were in it, we ventured to lodge

* "Smeaton and Lighthouses" (ed. 1844), pp. 24, 25; Smiles, "Lives of the Engineers," ii. 17.



WINSTANLEY'S LIGHTHOUSE AT THE EDDYSTONE.

there soon after midsummer, for the greater dispatch of the work. But the first night the weather came bad, and so continued, that it was eleven days before any boats could come near us again; and not being acquainted with the height of the sea's rising, we were almost drowned with wet, and our provisions in as bad a condition, though we worked night and day as much as possible to make shelter for ourselves. In this storm we lost some of our materials, although we did what we could to save them; but the boat then returning, we all left the house to be refreshed on shore: and as soon as the weather did permit we returned and finished all, and put up the light on the 14th November 1698; which being so late in the year, it was three days before Christmas before we had relief to go on shore again, and were almost at the last extremity for want of provisions; but, by good Providence, then two boats came with provisions and the family that was to take care of the light; and so ended this year's work."

The fourth year was devoted to strengthening the foundations and enlarging the structure, which, when completed, resembled nothing so much as "a Chinese pagoda, with open galleries and fantastic projections." The gallery around the lantern was so wide and open, that it was possible, when the sea ran high, for a six-oared boat to be lifted by the waves and driven through it. Such an edifice could not long resist the fury of the waters or the violence of the gale; but, at least, it served to prove that a lighthouse *could* be erected on the rock, and its achievement was one of the most laudable enterprises which any heroic mind could undertake, for it filled the breast of the mariner with new hope.

Winstanley was proud of his work, and so convinced, it is said, of its entire solidity, that he expressed a wish to be beneath its roof in the greatest storm that ever blew under the face of heaven, convinced that it could not shake one joist or beam. He had his presumptuous wish fulfilled. With his workmen and keepers he had taken up his abode in the lighthouse, when a terrible gale blew up, and on the 26th of November attained to an unparalleled excess of fury. In truth, it was of so frightful a character that contemporary annals vividly record its destructive effects, and the alarm it produced.

All through that memorable night the tempest raged. As soon as morning came the people of Plymouth hastened to the beach, and turned their gaze instinctively towards the Eddystone. But no structure crowned the rock, over which the waves were tossing and swirling all unchecked. The lighthouse was swept away, and no vestiges remained of its adventurous occupants.

The question now arose, Who was to rebuild the lighthouse? Three years passed before it was answered; and then the task was taken up by one Captain Lovet, who obtained a ninety-nine years' lease from the Trinity Corporation, and immediately engaged as his architect a *silk-mercer* on Ludgate Hill, named John Rudyerd. What reasons guided Lovet in his curious choice we cannot ascertain; probably Rudyerd had given some signal proofs of mechanical ingenuity; but, at all events, the choice proved a felicitous one. Rudyerd submitted for the new building an elegant and admirable design; instead of a polygon, he chose a circle for the outline, and instead of the projections and ornaments with which Winstanley had arrested every breeze that blew, he studied the utmost simplicity, so as to offer wind or wave the slightest possible resistance.

He secured the foundation with the utmost care. He divided the irregular surface of the rock into seven rather unequal stages, and cut thirty-six holes in these, to the depth of from twenty to thirty inches. These holes were six inches square at the top, gradually narrowing to five inches, and then again expanding and flattening to nine inches by three at the bottom. Into these dove-tailed holes strong iron bolts or branches were keyed; each bolt being fitted exactly in size to the hole it was intended to fill, and weighing from two to five hundredweight, according to its length and structure.

The bolts made fast, Rudyerd proceeded to fix a course of squared oak timbers lengthwise upon the lowest step, so as to reach the level of the step above. Another set of timbers were then laid crosswise, so as to cover those already laid, and to raise the level surface to the height of the third stage. The third structure was again laid lengthwise, the fourth crosswise, and so on, alternately, until a basement of solid wood was secured, two courses higher than the highest point of the rock; all being fitted together and to the rock, by means of the bolts, as firmly as possible, and all, in their intersections with one another, being closely trenailed.

The bolts originally let into the solid rock were perforated in their upper parts—some with three, and some with four holes; so that in every pair, collectively called a *branch*, there would be about seven holes. As the branches numbered thirty-six, there would be 252 holes, each about seven-eighths of an inch in diameter, and consequently as many large " bearded spikes " or " jag-bolts," which, being driven through the branches into the solid timber, held the mass firmly down.

Rudyerd's lighthouse is generally described as a timber edifice. This is not correct. Knowing that weight is best resisted and counteracted by weight, and to insure a sufficient amount of resistance, he combined with his courses of timber solid courses of Cornish granite, in this manner: the foundation was of oak for two courses; then came five courses of stone, each a foot in thickness, kept together by iron cramps; and then two courses more of timber. Thus was completed the basement.

The remainder of the edifice, which rose to an elevation of 69 feet, on a base of 23 feet, was built of timber. The interior consisted of four rooms, one above the other; and above the topmost was the lantern—an octagon of 10 feet 6 inches in diameter, crowned by a ball of 2 feet 3 inches in diameter. The whole height of the lighthouse, from the lowest side of the rock to the top of the ball, was 92 feet. It was completely finished in 1709.

In connection with this ingenious structure an anecdote is always related, illustrative of the kindly feeling which Louis XIV. occasionally exhibited. There was war at the time between England and France, and a French privateer seized the opportunity of carrying off the workmen employed in building the lighthouse as prisoners. As soon as their capture was made known to the king, he ordered their immediate release, and that they should be sent back to their work, with some presents to compensate for their detention. "Though at war with England," said the king, "I am not at war with mankind." The Eddystone lighthouse is so situated as to be of equal service to all nations having occasion to navigate the Channel that separates France from England.

Yet another anecdote: Some visitors to the lighthouse, after inspecting its internal arrangements, observed to one of the keepers that he thought it quite possible to live very comfortably in its quiet seclusion. "That might be," said the man, "if we had but the use of our tongues; but it is now fully a month since my partner and I have spoken to each other."

Rudyerd's lighthouse continued to brave "the elemental fury," and warn the seamen from the fatal rocks, until the 2nd of December 1755, when it fell before a most unexpected enemy. Through some unknown cause the building caught fire. Three keepers at the time were within the lighthouse; and when one of them, whose turn it was to watch, entered the lantern, at about two o'clock in the morning, to snuff the candles, he discovered it to be filled with smoke,* and on his opening the door which led to the balcony, a flame instantly burst from the inside of the cupola. He hastened to alarm his companions, and they used every exertion to extinguish the fire; but, owing to the difficulty of raising a sufficient supply of water to the top of the building, and the dryness of the internal timber, they soon found their efforts

* It is obvious that this could never have happened had the modern regulation been in force which forbids the lantern, after the light is once exhibited, being left without the presence of a keeper.

vain, and as the fire increased in force, were compelled to retreat downwards from stage to stage.

Early in the morning the fire was descried by some fishermen, who carried the news ashore, and a well-manned boat was immediately dispatched to the relief of the poor keepers.

It reached the Eddystone at ten o'clock, when the fire had been burning eight hours. The light-keepers had been driven from the building to avoid the falling beams, and molten lead and red-hot iron; and were found, stupefied with terror, in a cave on the east side of the rock. With difficulty they were removed into the boat, and carried ashore. No sooner were they landed than one of them, strange to say, immediately made off, and was never afterwards heard of. So singular a circumstance naturally engendered a suspicion that he had originated the fire; but when we remember that a lighthouse affords no means of retreat for its inmates, and that the probability is they will perish with it, we can barely believe it to be the place which an incendiary would choose for his nefarious design. As Smeaton says, we would rather impute the man's sudden flight to that kind of panic which sometimes, on important occasions, overpowers a weak mind; making it act without reason, and influencing it to commit unwittingly the most preposterous and injurious mistakes.

Of the other two light-keepers, one, named Henry Hall, met his death in an extraordinary manner. While engaged in throwing some buckets of water on the flaming roof of the cupola, he happened to look upwards, and a quantity of lead, melted by the heat, descended suddenly from the roof, and fell on his head, face, and shoulders, burning him severely. His mouth was open at the time, and he persisted in declaring that a portion of the lead had gone down his throat. The medical practitioner who attended him after his removal ashore not unnaturally regarded the story as incredible; but the man continued to grow worse, and on the twelfth day of his illness, after some violent spasms, expired. A post-mortem examination of his body was then made, and the poor man's assertion found to be literally true, for in the stomach lay a flat oval piece of lead seven ounces and five drachms in weight.

Before we quit the subject of Rudyerd's Lighthouse, we must refer to another romantic narrative of which it was the scene.

For some years after its establishment it was attended by two custodians only, whose duty it was to keep the windows of the lantern clean, and who were on guard for four hours alternately. Each at the conclusion of his watch was bound to call the other, and before he retired, to see that his successor took up his proper post. It happened, however, that, on one occasion, when the keeper on duty went to call his colleague, he found him—dead. Immediately he hoisted his flag on the balcony, from whence it was visible at the Rame Head, near Plymouth, and waited eagerly for the assistance this signal usually brought. Unhappily, the weather became so boisterous that no boat could put out from the shore, and the lonely keeper was reduced to the miserable companionship of a dead body. It is difficult to conceive of any situation more wretched or alarming; he dared not dispose of the corpse; for if he flung it into the waves—his only means of getting rid of it—he justly feared that he might be charged with the murder of his companion; and yet, each day that it remained, his own life was endangered by its extremely offensive condition. For nearly a month this long agony lasted. When, at last, a boat succeeded in reaching the rock, the building was found to be filled with an intolerable odour, and the corpse in such a condition that it was impossible to remove it to Plymouth for interment; it was therefore consigned to the deep.

This incident led to the employment thenceforward of three keepers, so that in case one of them died, or was sick, there might always be two on duty.

The value of a lighthouse on the Eddystone had been so abundantly proved, and, owing to the rapidly increasing commerce of the kingdom, its necessity was now so absolute, that the authorities resolved to lose no time in erecting a new one in the place of Rudyerd's unfortunate structure.

As on the two previous occasions, says Mr. Smiles, when, first, a country gentleman, and, next, a London mercer, had been called upon to undertake this difficult work, the person now appointed was neither a builder, an architect, nor an engineer, but a mathematical instrument maker. John Smeaton, however—to whom the difficult task was entrusted—had already given proof of a signal capacity for mechanics, and in the general estimation of scientific men no better or more fortunate selection could possibly have been made.

At this time Smeaton was only thirty-two years of age, having been born at Austhorpe Lodge, near Leeds, on the 8th of June 1724. His father was a respectable attorney, but, from his earliest youth, John Smeaton had exhibited a natural predisposition for the engineer's business. In truth, he was a mechanic born; in his childhood his play-things were mechanical tools; and before his sixth year he had designed a windmill and the model of a pump. He was sent to school at Leeds, but seems to have made no progress in any other branches than geometry and arithmetic. He occupied his holidays with mechanical pursuits, and on one occasion constructed a forcing-pump, which exhausted all the water in his father's fish-pond. At the age of fourteen he was an adept at smithery and turnery. He forged his iron and steel, and melted his metal. Tools had he in abundance, and of every kind, for working in metals, wood, or ivory. What was to be done with such a lad? His father wished him to be a "gentleman," and follow his own profession; Smeaton was content to become an "operative," and apprenticed himself to a mathematical instrument maker. He soon attained to such proficiency, that, in 1750, he commenced business on his own account. In 1751 he invented a machine to measure a ship's way at sea, as also a compass of peculiar construction. Enlarging the range of his studies, he submitted to the Royal Society, in 1752, some improvements which he had contrived in the air-pump, and experiments on the natural power of water and wind to turn mills and other machines dependent on circular motion.

Such was the man—ingenious, able, earnest, patient, and persevering—to whom was entrusted the erection of the *third* lighthouse upon the Eddystone rock.

On examining into the nature of the work he was required to undertake, his first conclusion was, that both Winstanley's and Rudyerd's lighthouses had been deficient in want of *weight*, and he announced it as his intention to build a structure of such solidity that the sea should give way to the lighthouse, and not the lighthouse to the sea. He therefore resolved to build it of stone.

His predecessors had lost much valuable time from the difficulty of landing on the rock, and of working on it continuously for any considerable period. To obviate this, Smeaton decided on mooring a vessel within a quarter of a mile of it, which should accommodate the workmen and their tools, and enable them to seize every favourable opportunity of putting out their boat and carrying their materials to the Eddystone, instead of making a long voyage from Plymouth on each occasion.

With respect to the *form* of his intended erection, he resolved to adopt Rudyerd's idea of a cone, but to enlarge the diameter considerably, and, on the whole, to keep before him as a model the trunk of a stately oak tree.*

The first actual work done on the rock was in August 1756, but the autumn was mainly occupied in the transportation and preparation of the granite and other materials, and in excavating the steps or stages for the reception of the foundation.

Early in June 1757 Smeaton resumed his task with

* This is Smeaton's own statement, but the reader is referred, for Mr. Alan Stevenson's view of it, to p. 98.

great energy and decision. On the 12th, the first stone was laid, weighing two tons and a quarter. On the next day the first course was finished, consisting of four stones. These were ingeniously dove-tailed together, and into the rock, so as to form a compact mass, from which it was impossible to separate any particular stone. The sloping form of the rock, remarks Mr. Smiles,* to which the foundation of the building was adapted, required but this small number of stones for the first course; the diameter of the building increasing until it reached the level of the rock. Then the second course, completed on the 30th of June, consisted of thirteen stones; the third, completed on the 11th of July, of twenty-five pieces; the fourth, on the 31st, of thirty-three. The sixth course was finished on the 11th of August, and rose above the general wash of the tide, so that Smeaton might fairly consider he had surmounted the greatest difficulties of his task.

Up to this level, the highest point of the rock, all the courses had been begun by the stones that were securely dove-tailed into the rock, and also made fast by oak wedges and cement. To receive these wedges, a couple of grooves were cut in the waist of each stone, from the top to the bottom of the course, an inch deep and three inches wide. We borrow from Smeaton's own narrative his description of the manner in which each stone was laid:—

"The stone to be set being hung in the tackle, and its bed of mortar spread, was then lowered into its place, and beaten with a heavy wooden mall, and levelled with a spirit-level; and the stone being accurately brought to its

* Smiles, "Lives of the Engineers," ii. 38.

marks, it was then considered as set in its place. The business now was to retain it exactly in that position, notwithstanding the utmost violence of the sea might come upon it before the mortar was hard enough to resist it. The carpenter now dropped into each groove two of the oaken wedges, one upon its head, the other with its point downwards, so that the two wedges in each groove would lie heads and points. With a bar of iron about two inches and a half broad, a quarter of an inch thick, and two feet and a half long, the ends being square, he could easily (as with a rammer) drive down one wedge upon the other; very gently at first, so that the opposite pairs of wedges, being equally tightened, they would equally resist each other, and the stone would therefore keep place. A couple of wedges were also, in like manner, pitched at the top of each groove; the dormant wedge, or that with the point upward, being held in the hand, while the drift-wedge, or that with its point downward, was driven with a hammer. The whole of what remained above the upper surface of the stone was then cut off with a saw or chisel; and, generally, a couple of thin wedges were driven very moderately at the butt-end of the stone; whose tendency being to force it out of its dove-tail, they would, by moderate driving, only tend to preserve the whole mass steady together, in opposition to the violent agitation that might arise from the sea."

When the stone was firmly secured, the next step was to liquefy a certain portion of mortar; and the joints having been carefully pointed, up to the upper surface, this mortar or cement was poured in with iron ladles so as to occupy every empty space. The more consistent parts of the cement naturally fell to the bottom, and the watery were absorbed by the stone; the vacancy thus left at the top was repeatedly refilled, until all remained solid; then the top was pointed, and, where necessary, defended by a layer of plaster.

The whole of the foundation having thus been elevated to a proper level, some other means was required to obtain a similar amount of security for the substructure.

A hole of one foot square was accordingly cut right through the middle of the central stone in the sixth course; and at equal distances in the circumference were sunk eight other depressions of one foot square and six inches deep. A strong plug of hard marble, from the rocks near Plymouth, one foot square, and *twenty-two inches* long, was set with mortar in the central cavity, and driven firmly into it with wedges. As this course was *thirteen inches high*, it is evident that the marble plug which reached through it rose *nine inches* above the surface. Upon this was fixed the central stone of the next course, having a similar bore in its middle, bedded with mortar, and wedged as before. By this means, no force of the sea acting horizontally upon the central stone, unless it was able to cut in two the marble plug, could move it from its position; and the more effectually to prevent the stone from being lifted, in case its bed of mortar should chance to be destroyed, it was fixed down by four trenails. The stones surrounding the central were dovetailed to it in the same manner as before, and thus one course rose above another, with no other interruption than the occasional violence of the waves or inclemency of the weather.

In every stage of the laborious and difficult work Smeaton himself was foremost. When it had proceeded so far as to present the appearance of a level platform, he could not deny himself the gratification of enjoying the limited promenade which it afforded; but making a false step, and being unable to recover himself, he fell over the brink of the work, and among the rocks on the west side. The tide having retired, he sustained no very serious injury; but he dislocated his thumb, and as no medical assistance could be procured, set it himself, and returned to his work. The incident is characteristic of the courage and tenacity of the man.

The ninth course was laid on the 30th of September, and the weather becoming boisterous, further operations were suspended for that year.

The following winter was very tempestuous, and it was the 12th of May before Smeaton and his workmen again saw the Eddystone. To their delight and surprise they found the entire work in the same condition as when they left it. The cement appeared to have become as hard as the stone itself, the whole being concreted into one solid mass.

Thenceforward the work made vigorous and successful progress, and, by September, the twenty-fourth course was reached and laid. This completed what is called "the Solid" part of the building, and formed the floor of the store-room; so that Smeaton had no reason to be dissatisfied with the operations of the season. But as he had long been meditating on the advantage to the public which would accrue if a light could be exhibited that very winter, he resolved on a vigorous effort to complete the store-room and erect a light above it.

The building, says an accurate authority,* had hitherto been carried up solid as high as there was any reason to imagine it would be subjected to the heavy rush of the sea; that is, to 35 feet 4 inches above its base, and 27 feet above the top of the rock, on the common spring-tide high-water mark. At this elevation it was reduced to 16 feet 8 inches diameter; and it was needful to make the best use of this space, and economize it to the utmost advantage consistent with the one primary and indispensable condition of *strength*. The rooms were built with a diameter of 12 feet 4 inches, having for the walls a thickness of 2 feet 2 inches. These walls were made of single blocks, and so shaped that a complete circle was formed by sixteen pieces, which were cramped together with iron, and also secured to the lower courses by marble plugs as before. To prevent any humidity penetrating through the vertical joints, flat stones were introduced into each, in such a manner as to be lodged partly in one stone and partly in another. With all these ingenious precautions, the twenty-eighth course was completely set on the 30th of September.

This, and the next course, received the vaulted floor, which formed at once the *ceiling* of the store-room, and the *floor* of the upper store-room. For additional security, therefore, a groove was cut round the upper surface of the course, in which was lodged a massive chain of iron. Upon this chain, in the groove, melted lead was poured, until the cavity was filled up. The next course was laid

* "Smeaton and Lighthouses" (edit. 1844), pp. 57, 58.

and completed in a similar manner; and by the 10th of October Smeaton had nearly perfected his arrangements for establishing a light and light-keepers at the Eddystone, when his hopes were suddenly stricken by a prohibition from the Trinity House, based upon legal difficulties.

SMEATON'S LIGHTHOUSE AT THE EDDYSTONE.

But this being at last removed, the work was recommenced for the next and last season on the 5th of July. On the 21st, the second floor was finished; on the 29th, the fortieth course was laid, and the third floor finished.

On the 17th of August 1759, the main column of the lighthouse was completed. Forty-six courses of masonry had been laid, and the graceful structure raised to its specified height of seventy feet. The last work done, very appropriately, was the engraving of the words "Laus Deo" (Praise be to God!) on the last stone set over the lantern. At an earlier date, Smeaton, with devout humility, had inscribed on the course beneath the ceiling of the upper store-room, "Except the Lord build the house, they labour in vain that build it." The iron-work of the balcony and the lantern were next erected, and the whole was surmounted by a gilt ball.

The internal arrangements of the lighthouse were as follow:—

First, the store-room, with a doorway, but no windows.

Second, the upper store-room.

Third, the kitchen, with a fireplace and sink, two settles with lockers, a dresser with drawers, two cupboards, and a rack for dishes.

Fourth, the bedroom, with three cabin-beds, to hold one man in each, with three drawers and two lockers in each to receive his separate property.

Fifth, the lantern, in which a seat was placed all round, except at the doorway.

Besides the windows of the lantern, ten other windows were constructed for the edifice—namely, for the store-room two, and for each of the upper rooms four. In fixing their bars, an accident happened to Smeaton, which was nearly attended with fatal results.

"After the boat was gone," he says, "and it became so dark that we could not see any longer to pursue our occupations, I ordered a charcoal-fire to be made in the upper store-room, in one of the iron pots we used for melting lead, for the purpose of annealing the blank ends of the bars; and they were made red-hot altogether in the charcoal. Most of the workmen were set round the fire, and by way of making ourselves comfortable, by screening ourselves and the fire from the wind, the windows were shut; and, as well as I remember, the copper cover or hatch put over the man-hole of the floor of the room where the fire was—the hatch above being left open for the heated vapour to ascend. I remember to have looked into the fire attentively to see that the iron was made hot enough, but not overheated: I also remember I felt my head a very little giddy; but the next thing of which I had any sensation or idea was finding myself upon the floor of the room below, half drowned with water. It seems that, without being further sensible of anything to give me warning, the effluvia of the charcoal so suddenly overcame all sensation, that I dropped down upon the floor; and had not the people hauled me down to the room below, where they did not spare for cold water to throw in my face and upon me, I certainly should have expired upon the spot."

Escaping this and other perils, Smeaton saw his beautiful edifice finally brought to completion; and on the 16th of October a light was once more shown from the Eddystone rock.

The lighthouse has now, as Mr. Smiles remarks, withstood the storms of upwards of a century—a solid monument to the genius of its architect and builder. Sometimes, he says,* when the sea rolls in with more than ordinary fury from the Atlantic, and the billows are driven up the Channel by the force of a south-west wind, the lighthouse is enveloped in spray, and its light momentarily obscured. But the shadow passes, and once more it beams across the waters like a star, a signal and a warning to the homeward bound. Occasionally, when a

* Smiles, "Lives of the Engineers," ii. 45.

strong wave strikes it, the central portion of the wave shoots up the perpendicular shaft and leaps quite over the lantern. At other times, a colossal billow hurls itself upon the lighthouse, as if to shake it from its foundation; and to its inmates the shock is like that of a cannon; the windows rattle, the doors jar, and the building trembles to its very base. But the vibration felt throughout the lighthouse on such an occasion, instead of being a sign of weakness, is the best evidence that can be desired of the unity of the fabric and the cohesion of all its parts.

When the Eddystone was built, scarcely any other light guided the mariner in his intricate navigation of the Channel; but now it is abundantly illuminated along its whole extent, and its course is almost as easily tracked as that of a main thoroughfare in London. First comes the St. Agnes Light, on one of the Scilly Isles, revolving every minute, at an elevation of 138 feet above high water. Next are made the two Lizard Lights, which crown the rugged cliffs at the southernmost point of the English coast. In the deep curve between this bold headland and the craggy promontories of Bolt Head and Start Point, lie the revolving light on St Anthony's Point, and the two lights on Plymouth Breakwater; while out at sea, almost in front of Plymouth Sound, and midway between the Lizard and the Start, the waves beat and swirl around the Eddystone. On Start Point there are two lights: one revolving, for the Channel; and another fixed, to guide ships inshore clear of the Skerries.

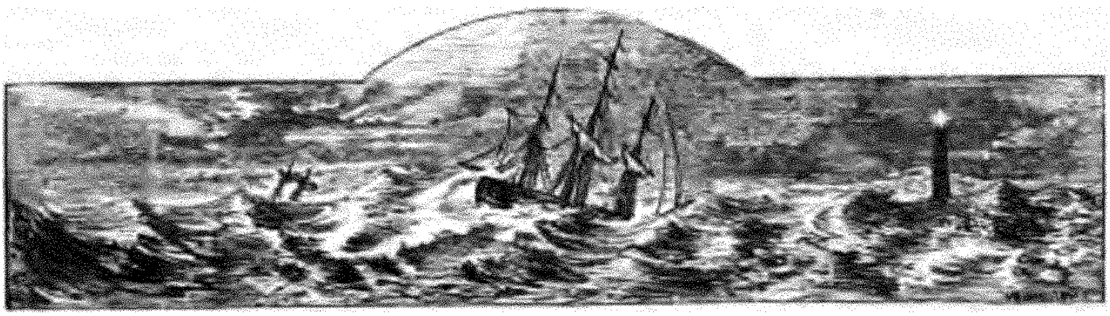
Continuing our voyage up Channel, we see on the south, off the coast of Jersey, the three Casquet Lights, and on the north the two fixed lights of Portland Hill. If we make for Portsmouth, we are guided by the light on the outermost Needle Rock and the harbour signals;

THE LIGHTSHIP AT THE NORE.

but keeping out at sea we pass St Catherine's, on the extreme southerly headland of the Isle of Wight and next, the lights displayed at different heights on the Nab, and the single fixed light on the Owers vessel.

At Beachy Head the light, which revolves in two minutes, is 285 feet above high water. At Dungeness, the light, a red one of great power, is situated on the low projection of Dungeness beach. Next are sighted the harbour lights of Folkestone and Dover; whilst on the French coast beams the flashing light of the Varne Bank, and the splendid revolving light of Cape Grisnez.

We quit the Channel with the South Foreland Lights, one above the other, on our left, and enter the historic waters of the Downs—so often traversed by the keels of our victorious fleets—with the South Sandhead floating light on the right. Then, on the one hand, our course is guided by the floating lights of the Gull and the North Sandhead—on the other by the friendly ray of the North Foreland lighthouse—until we reach the broad estuary of the Thames, where the lightship of the Nore marks the entrance of the greatest marine highway in the world.



CHAPTER II.

THE SMALLS LIGHTHOUSE.

THE motive which inspired the founder of the Smalls Lighthouse was of a higher order than those of most of his contemporaries. In erecting a warning light upon these dangerous rocks, Mr. Philips (for this was his name) proposed to himself, as his great and enduring recompense, "to serve and save humanity." But, in this instance, generosity met with its due reward even upon earth; and when the descendants of the philanthropist disposed of their establishment to the Trinity House, they received, by way of compensation, a sum of £15,000.

The undertaking which Philips set himself was one of no ordinary difficulty, of no common danger. The rock on which he resolved to erect his lighthouse, in ordinary weather rose fully twelve feet above the water; but when the waves were heavy—a very common occurrence in those parts—it was completely submerged. And in Philips's time engineers were not so numerous as they are to-day; the professors and practical expositors of science were then but few, were misunderstood, frequently persecuted or slandered, notwithstanding the precious contributions they were making yearly to the great sum of human knowledge and human happiness. Philips, therefore, searched far and wide before he discovered a man able to carry out his idea. At length he found him, but neither among architects nor engineers; the assistant he chose was named Whiteside, a musical instrument maker at Liverpool, and gifted with a remarkable aptitude for mechanical pursuits.

It was in the summer of 1772 that Whiteside first explored the maze of rocks, with which it is no flight of fancy to say his name will be ever associated. He landed on the Smalls with a gallant little band of Cornish miners; but the obstacles which he encountered at the very beginning might well have disgusted him with the enterprise. Scarcely was the foundation begun, before the weather suddenly grew tempestuous, and so furious was the gale, that the cutter which had disembarked them was compelled to weigh anchor and put to sea. The unfortunate workmen left upon the rock clung to it as best they might—clung to it as a drowning seaman to the fragment of broken spar which alone interposes between him and death; and in this wretched position they remained for two days and nights. Yet even this rough prelude could not discourage Whiteside, and he persevered through a long series of difficulties and dangers until his task was finished.

One day the dwellers on the neighbouring coast picked up on the beach what is so expressively called "a message from the sea"—namely, a strip of paper enclosed in a

bottle very carefully sealed—the bottle itself being deposited in a cask or barrel. On the barrel were written these words:—

"Open this, and you will find a letter."

The finders obeyed the injunction, and found the following:—

"THE SMALLS, *February* 1st, 1777.

"Sir,—Being now in a most dangerous and distressed condition upon the Smalls, do hereby trust Providence will bring to your hand this, which prayeth for your immediate assistance to fetch us off the Smalls before the next spring, or we fear we shall perish; our water near all gone, our fire quite gone, and our house in a most melancholy manner. I doubt not but you will fetch us from here as fast as possible; we can be got off at some part of the tide almost any weather. I need say no more, but remain your distressed,

"Humble servant,
"H. WHITESIDE."

Beneath this signature a postscript had been added:—

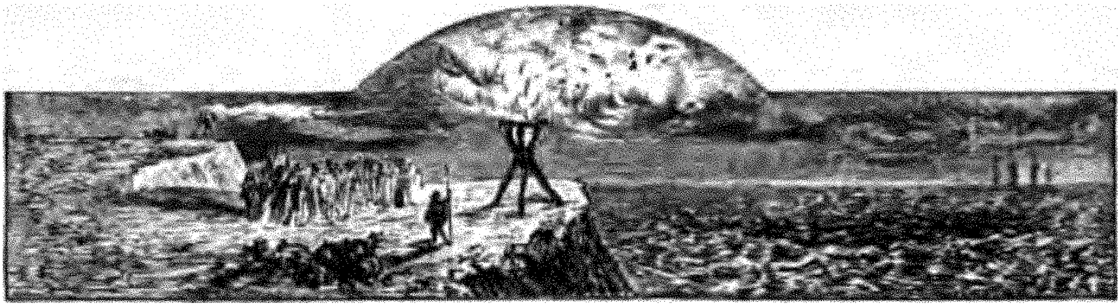
"We were distressed in a gale of wind upon the 13th of January, since which have not been able to keep any light; but we could not have kept any light above sixteen nights longer for want of oil and candles, which makes us murmur and think we are forgotten.

"EDWARD EDWARDS, G. ADAMS, J. PRICE.

"*P.S.*—We doubt not that whoever takes up this will be so merciful as to cause it to be sent to Thomas Williams, Esq., Trelethin, near St. David's, Wales."

There are sadder pages than this, however, in the brief chronicle of the Smalls, and one bears a close resemblance to a painful incident associated with the Eddystone. It is said that early in the present century, and in a stormy winter of peculiar severity, the light-keepers were deprived of all communication with the land for a period of four months. It was in vain that ships were dispatched towards the rocks; a raging sea invariably prevented their approach. One of them returned, on a certain occasion, with the singular intelligence that her crew had observed a man standing upright and motionless, in a corner of the outer gallery, with a flag of distress floating beside him. But whether he was alive or dead, none could say, or even imagine. Every night the gaze of the inhabitants of the shore was anxiously directed towards the lighthouse, to see if the lamp was kindled; and every night the welcome ray shone punctually—a proof that there was still a keeper at the Smalls. But were the two guardians living; and if only one, which of the two survived? The curiosity of all, and the deep anxiety of some, daily increased, as day after day passed without further intelligence from the sea-girt rock.

One evening a fisherman of Milford contrived to land on the lighthouse rock in an interval of calm, and to carry back to Solva the two keepers; but of the two one was a corpse. The survivor had made a kind of shroud for his dead comrade, and afterwards placed him upright in the gallery, and securely bound him. This he did to avoid the odour which would have arisen from a dead body preserved within the lighthouse, and yet to let it remain for the examination of the surgeons, lest any suspicion of foul play should attach to him.



CHAPTER III.

THE BELL ROCK, A.D. 1807–1811.

IN the arts of peace a noble rivalry exists between the sister kingdoms of Great Britain; and as England may boast in her Eddystone tower of a splendid work of science and philanthropy, and in her Smeaton of an engineer not less remarkable for genius than resolution, so may Scotland proudly point to the lighthouse on the Bell Rock as a national monument, and to her Robert Stevenson as scarcely inferior to Smeaton in skill and intrepidity.

We have already stated that the charge of lighting the Scottish coast—which, owing to its exposure to heavy seas and furious winds, to its numerous rocks and islands and rugged promontories, is one of the most dangerous in Europe, perhaps in the world—is intrusted to a body called the "Commissioners of Northern Lights," incorporated by Act of Parliament in 1786. At first the erection of only *four* lights was contemplated: at Kinnaird Head, in Aberdeenshire; on the Orkney Islands; on the Harris Islands; and at the Mull of Kintyre, in Argyleshire. But the vast development of the commerce of Scotland soon called for additional assistance to the navigators of her waters, and at the present time her shores are surrounded with a ring of warning lights.

The most ancient public light on the Scottish coast is that situated on the Isle of May; an island which, like a natural breakwater, lies off the mouth of the Firth of Forth, and commands, as it were, the great highway to the Scotch capital and its prosperous port. It seems to have been erected at a very early period; and over the entrance-door of the weather-beaten tower is cut the figure of the sun, with the date of 1635.

After the Union, very considerable discontent was expressed by the English and Irish merchants that, for the maintenance of this beacon, they were charged exactly double the rate paid by Scottish vessels. They also complained of the insufficiency of the light, which was simply a coal-fire exposed in an open chauffer, or brazier. The Edinburgh Chamber of Commerce taking up the matter, the proprietor of the light consented to increase its magnitude, and accordingly enlarged his chauffer to three feet square, doubling the consumption of coal, which had formerly been about 200 tons per annum. Thenceforth it became the "most powerful coal-light in the kingdom;" but, owing to its exposure, was frequently unsteady in foul weather; and, moreover, was apt to be confused with the lime-kilns and accidental fires on the neighbouring coast. The Duke of Portland had by this time become proprietor—through marriage—of the light and the island; but to repeated applications that he would substitute an oil-light and reflectors for the wavering and uncertain coal-fire, he turned a deaf ear. At length, on the 19th of December 1810, two men-of-war were wrecked near Dunbar, in consequence, it was believed, of a lime-kiln on the Haddingtonshire coast being mistaken for the Isle of May light. The Admiralty were thus led to interfere, and, after some negotiations with the Duke of Portland, an Act of Parliament was passed in 1814 empowering the Commissioners of Northern Lights to purchase the island and its lighthouse for a sum of £60,000. The tolls were then reduced to an uniform scale, a new tower was erected, and a light on the catoptric system was first exhibited on the 1st of February 1816.

Meanwhile, the progress made in lighting other important points of the Scottish coast had been considerable. The lighthouse at Grass Island in Harris was completed on the 10th of October 1789. On the same date was kindled a light at North Ronaldshay, in Orkney. In 1790, on the 1st of October, a light was exhibited at Pladda, a small island south-west of Arran, in the Firth of Clyde. As a guide to the Pentland Firth a lighthouse was erected on the Pentland Skerries in 1794. The Skerries are a couple of desolate islands, exposed to the stress of the North Sea and the currents of the Pentland Firth; and the works here consist of an upper and lower lighthouse, respectively 100 and 80 feet above the sea-level, and 60 feet apart. They deserve our special notice as the first memorials of the skill and energy of Robert Stevenson as an engineer. He was on the spot when the two lights were first exhibited, October 1, 1794; and, his task completed, sailed from Orkney on the 9th of October in the sloop *Elizabeth.*

On the following day he landed within a few miles of Kinnaird Head lighthouse, and continued his journey to Edinburgh by road, reaching the capital in safety. A different fate, however, awaited his former companions; the sloop having put back to Cromarty Roads, was afterwards driven to Orkney, and ultimately lost, when all on board perished.*

We have spoken of a lighthouse erected on North Ronaldshay in 1789. An experience of twelve years showed that its position had been unfortunately selected, and that it by no means assisted the mariner in navigating the difficult straits of the Orkney archipelago. Every winter ships were cast away, and precious lives were lost, on the islands of Stronsay and Sanday, though the latter is only eight miles distant from North Rolandshay. In 1796 three homeward-bound vessels were lost on this fatal island, and eight more in the next three years. It was therefore resolved, in 1801, that a beacon, or tower of masonry, should be erected upon the Start Point, or eastern extremity of the low shores of the island of Sanday; and erected in such a manner that, if found necessary, it might be converted into a lighthouse.

In 1802 Mr. Stevenson sailed on his annual voyage of inspection to the Northern Lighthouses, carrying with him a foreman and sixteen artificers to commence the works on Start Point. It was the month of April, but, even at this advanced period of the season, the Orkney Islands were

* Robert Stevenson, "Account of the Bell Rock Lighthouse," p. 17 (Edit. 1824).

found covered to the depth of six inches with snow. Operations were commenced, however, without a day's delay: a sandstone quarry was opened on the adjacent island of Edda; and by the middle of May sufficient materials were collected for the commencement of the edifice. The foundation-stone was laid, with masonic ceremonies, on the 15th of May, when an address was delivered by Mr. Traill, the minister of the parish, some portions of which may be preserved in these pages :—

"The moment is auspicious. The foundation-stone is laid of a building of incalculable value;—a work of use, not of luxury. Pyramids were erected by the pride of kings to perpetuate the memory of men whose ambition enslaved and desolated the world. But it is the benevolent intention of our Government on this spot to erect a tower—not to exhaust, but—to increase the wealth and protect the commerce of this happy kingdom. . . . .

"Consider the great national objects for which this building will be erected. To protect commerce, and to guard the lives of those intrepid men who for us cheerfully brave the fury of the waves and the rage of the battle. The mariner, when he returns to the embraces of his wife and children, after ascribing praise to the great Giver of safety, shall bless the friendly light which guided him over the deep, and recommend to the protection of Heaven those who urged, who planned, and who executed the work. This day shall be remembered with gratitude. It shall be recorded that, at the beginning of a new century, the pious care of Government was extended to this remote island. These rocks, so fatal to the most brave and honourable part of the community, shall lose their terror, and safety and life shall spring from danger and death." *

By steadily prosecuting the works throughout the summer, they were brought to a fortunate completion in the month of September. The beacon rose to a height of 100 feet, and terminated with a massive ball of masonry, measuring fifteen feet in circumference.

It was found, however, that the construction of this beacon did not prevent the occurrence of frequent wrecks upon the island. It was proverbial with its inhabitants to observe, that if wrecks were to happen, they might as well be sent to the poor island of Sanday as anywhere else. In fact, the inhabitants of this and the neighbouring islands lived upon the proceeds of their wreckage, and melancholy remains of many a "tall ship" met the eye in every direction.

For example, says Mr. Stevenson, although quarries are to be generally met with in these islands, and the stones are very suitable for building dykes, yet instances occur of the land being enclosed, even to a considerable extent, with ship-timbers. A park † might be seen paled round, chiefly with cedar-wood and mahogany from the wreck of a Honduras-built ship; ‡ and in one island, after the loss of a ship laden with wine, the inhabitants took claret to their barley-meal porridge, instead of their usual beverage. When Mr. Stevenson complained to one of the pilots of

* Stevenson, "Account of the Bell Rock Lighthouse," p. 23.

† A "park," *Scottice* for a "field."

‡ Is it necessary to remind the reader that Honduras, on the Bay of Campeachy, is famous for its mahogany?

the badness of his boat's sails, he replied, with grim humour, "Had it been God's will that you came na here wi' these lights, we might a' had better sails to our boats, and more o' other things." A much higher rent was given for the farms than they were absolutely worth, in consideration of the profits that would probably accrue from wrecks on their respective shores.

Under these circumstances it was deemed advisable to convert the North Ronaldshay lighthouse into a beacon, and the Start Point beacon into a lighthouse, both transformations being successfully effected in the course of the year 1805; and the light exhibited on Start Point, January 1st, 1806.

Continuing our brief chronological resumé, we find that, for the better navigation of the noble estuary of the Forth, a lighthouse was erected on the island of Inchkeith—which lies nearly opposite the town of Portobello on the south shore, and Burntisland on the north—in 1805. Its base is 175 feet above the sea, and the building itself measures 45 feet in height. The light is a revolving one.

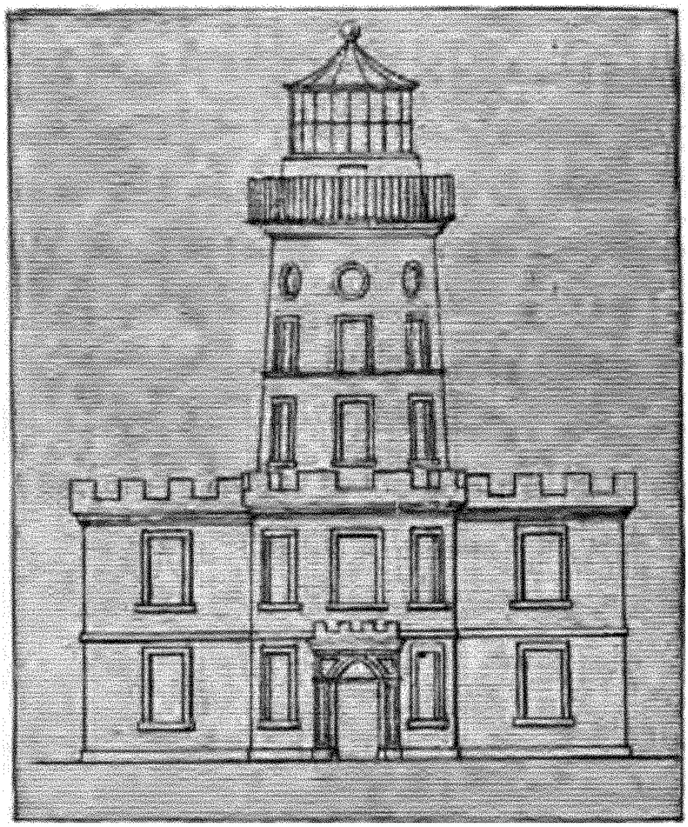
We now come to a description and historical account of the celebrated lighthouse to which this chapter is more particularly devoted.

PHAROS *loquitur.*

"Far in the bosom of the deep
O'er these wild shelves my watch I keep,
A ruddy gem of changeful light,
Bound on the dusky brow of Night:
The seaman bids my lustre hail,
And scorns to strike his timorous sail."

SIR WALTER SCOTT.*

* Written by the great novelist in the Album of the Lighthouse, when he visited it in 1816.



INCHKEITH LIGHTHOUSE.

The Inch Cape, or Bell Rock, is a "dangerous sunken reef." situated on the northern side of the entrance of the Firth of Forth, at a distance of eleven miles from the promontory of the Red Head, in Forfarshire; of seventeen miles from the island of May; and of thirty miles from St. Abb's Head, in Berwickshire. Its exact position is in lat. 56° 29′ N., and long. 2° 22′ E. Its extreme length is estimated by Mr. Stevenson at 1427 feet, and its extreme breadth at about 30 feet, but its configuration or margin is extremely irregular. The geological formation of the rock is a reddish sandstone, which in some places contains whitish and greenish spots of circular and oval forms. Its lower portions are covered with various aquatic plants, such as the great tangle (*fucus digitatus*), and the badderlock, or hen-ware (*fucus esculentus*); while the higher parts are clothed with the smaller fuci, such as *fucus marmillosus*, and *fucus palmatus*, or common dulse.

The name "Inch Cape" occurs in a chart published in 1583, and refers, we suppose, to its situation as an "inch," or island, off the Red Head promontory. Its better known appellation, "the Bell Rock," *may* allude to its bell-like figure, but more probably originated in the circumstance that a bell with a float was fixed upon it by a former abbot of Aberbrothock (Arbroath), in such a manner that it was set in motion by the winds and waves, and by its deep tones afforded a much-needed warning to navigators of the dangerous character of the spot.

In connection with this humane device—whose actual existence there seems no good reason to doubt—an old tradition has long been current, which Southey embodies with much picturesque effect in his well-known ballad of "Sir Ralph the Rover":—

> "No stir in the air, no stir in the sea,
> The ship was still as she could be;
> Her sails from heaven received no motion,
> Her keel was steady in the ocean.
>
> "Without either sign or sound of their shock,
> The waves flowed over the Inchcape Rock;
> So little they rose, so little they fell,
> They did not move the Inchcape Bell.
>
> "The Abbot of Aberbrothok
> Had placed that bell on the Inchcape Rock;
> On a buoy in the storm it floated and swung,
> And over the waves its warning rung.
>
> "When the rock was hid by the surge's swell,
> The mariners heard the warning bell;
> And then they knew the perilous rock,
> And blessed the Abbot of Aberbrothok.
>
> "The sun in heaven was shining gay,
> All things were joyful on that day;

The sea-birds screamed as they wheeled around,
And there was joyaunce in their sound.

"The buoy of the Inchcape bell was seen,
A darker speck on the ocean green;
Sir Ralph the Rover walked his deck,
And he fixed his eye on the darker speck.

"He felt the cheering power of spring,
It made him whistle, it made him sing;
His heart was mirthful to excess,
But the Rover's mirth was wickedness.

"His eye was on the Inchcape float;
Quoth he, 'My men, put out the boat,
And row me to the Inchcape Rock,
And I'll plague the Abbot of Aberbrothok.'

"The boat is lowered, the boatmen row,
And to the Inchcape Rock they go;
Sir Ralph bent over from the boat,
And he cut the bell from the Inchcape float.

"Down sunk the bell with a gurgling sound,
The bubbles rose and burst around;
Quoth Sir Ralph, 'The next who comes to the rock
Won't bless the Abbot of Aberbrothok.'

"Sir Ralph the Rover sailed away,
He scoured the seas for many a day;
And now grown rich with plundered store.
He steers his course for Scotland's shore.

"So thick a haze o'erspreads the sky,
They cannot see the sun on high;
And the wind hath blown a gale all day,—
At evening it hath died away.

"On the deck the Rover takes his stand,
So dark it is they see no land:
Quoth Sir Ralph, 'It will be lighter soon,
For there is the dawn of the rising moon.'

"'Canst hear,' said one, 'the breakers roar?
For methinks we should be near the shore;'
'Now where we are I cannot tell,
But I wish I could hear the Inchcape bell!'

"They hear no sound, the swell is strong;
Though the wind hath fallen they drift along,
Till the vessel strikes with a shivering shock,—
'O Christ! it is the Inchcape Rock.'

"Sir Ralph the Rover tore his hair,
He curst himself in his despair;
The waves rush in on every side,
The ship is sinking beneath the tide.

"But even in his dying fear
One dreadful sound could the Rover hear,—
A sound as if with the Inchcape bell
The devil below was ringing his knell."

It would be difficult to name a position on the Scottish coast where a lighthouse was more a matter of necessity for the safety of ships than this long-famous rock. The beacons which, one after another, had been erected upon it, the furious waves had swept away; and a structure was needed not less solid and permanent than that of the Eddystone. To design such a structure, and to plant it solidly amid the waves, became, in 1806, the task of Mr. Robert Stevenson. As the rock was frequently under water to the depth of twelve feet, the task was scarcely less difficult than that whose successful achievement has helped to perpetuate the name and fame of Smeaton.

On the 7th of August 1807 the work was begun. The first stage was the erection of a wooden workshop and residence for the artificers, and this apparently simple operation occupied the whole season, the supports having to be firmly fixed in holes dug out of the solid rock. The hardness and compactness of the sandstone, however, soon blunted their tools, and rendered necessary the constant employment of a smith with his forge. But it often happened, says Mr. Stevenson, to our annoyance and disappointment, in the early state of the work, when the smith was in the middle of "a favourite heat," and fashioning some useful article, or sharpening the tools, after the flood-tide had compelled the men to strike work, a sea would come rolling over the rocks, dash out the fire, and endanger that indispensable implement, the bellows; or, if the sea were smooth, while the smith often stood at work knee-deep in the water, the tide rose imperceptibly, first cooling the exterior of the fireplace, or hearth, and then quietly blackening and extinguishing the fire from below. Mr. Stevenson was frequently amused at the anxiety and perplexity of the unfortunate smith when coaxing his fire, and endeavouring in vain to contend against the rising tide. Obviously the work would go on but slowly, until the workshop (also intended to serve as a beacon) was completed, and the smith protected against the insidious waters.*

Dangers of a far more serious kind also beset the patient founders of the Bell Rock Lighthouse.

On the 2nd of September, after the first cargo of stones had been landed, and while thirty-two artificers were busily occupied in their various departments of labour, a gale arose, and the attendant vessel—named the *Smeaton*, after the great English engineer—broke adrift from her moorings. This unfortunate circumstance, at first, was known only to Mr. Stevenson and his landing-master, who fully appreciated the gravity of the situation—thirty-two men on an insulated rock, which, at flood-tide, lay twelve feet under water, with only two boats at hand, and these not capable in foul weather of carrying more than eight men each.

While the artisans were at work, chiefly in sitting and kneeling postures, excavating the rock, or boring with the

* Stevenson, "Account of the Bell Rock Lighthouse," p. 125. To prevent the repetition of useless references, we would here acknowledge that in the following pages we have closely followed Mr. Stevenson's own narrative.

tools, and while the din of their hammers and the clang of the smith's forge filled the air, there was sufficient life and motion in the scene to keep Stevenson's mind from fully realizing the dangers of his position. But by degrees the water began to rise, and with slowly-swelling waves it gained upon those engaged in work on the lower portions of the sites of the beacon and lighthouse. From the run of the sea upon the rock, the forge-fire was more quickly extinguished than usual; and the volumes of smoke having ceased, the men at work could examine every object around. After having had about three hours' work, the majority began to make towards their respective boats for their jackets and stockings, when, to their astonishment, instead of three boats, they found only two, the third being adrift with the *Smeaton*. Not a word was uttered, but all appeared to be silently calculating their numbers, while they gazed from one to another with dismay and perplexity plainly painted on their countenances. The landing-master, conceiving that he might be censured for allowing the boat to quit the rock, remained at a distance, while Mr. Stevenson placed himself on the most elevated crag, endeavouring to track the progress of the *Smeaton*, and surprised that the crew did not cut her boat adrift, as it greatly retarded her way. The workmen looked steadfastly upon their engineer, occasionally turning towards the vessel, which was still far to leeward.

All this took place in the most perfect silence, and the melancholy solemnity of the scene was such that it produced an ineffaceable impression on Mr. Stevenson's mind.

In the meantime the engineer was meditating various schemes which might be adopted for the general safety of the party. The most feasible seemed to be, that as soon as the waves should reach the highest summit of the rock, all should disembarrass themselves of their upper garments; and while a certain number went on board each boat, the remainder should hang by the gunwales, and the boats should row gently towards the *Smeaton*, as the *Pharos*, or floating-light, lay too much to the windward of the rock. Stevenson wished to propose this plan; but, on attempting to speak, his mouth was so parched that his tongue refused utterance, and he now learned by experience that the saliva is as necessary as the tongue itself for speech. Turning to one of the rock-pools, he lapped a little water, and obtained immediate relief. But great was his joy, when, on rising from this unpleasant beverage, a voice called out, "A boat! a boat!" and, on looking around, at no great distance a large boat loomed through the deep, and was evidently making for the rock. She proved to be a pilot-boat from Arbroath, express with letters; and willingly taking on board Stevenson and his company, rescued them from their critical position. In return for this service, the pilot was pensioned by the Lighthouse Commissioners in his old age.

On the 6th of September, the whole company on board of the light-ship, or *Pharos*, was surprised by a tremendous gale, which prevented them from approaching the rock for ten days, and exposed them to real danger.

About two o'clock P.M., says Stevenson, a very heavy sea struck the ship, flooded the deck, and poured into the berths below. Everybody thought that she had foundered, and that their last moment had come. Below deck total darkness prevailed; several of the artificers were at prayer, repeating hymns, or uttering devout ejaculations; others protested that if they should be fortunately spared to reach land once more, no one would induce them to tempt the treacherous waves again. Through the confusion Stevenson made his way upon deck. An astounding spectacle met his gaze. The billows appeared to be ten or fifteen feet in height of unbroken water, and each threatened the little vessel with immediate destruction; but still, with wonderful buoyancy, she continued to rise upon the waves, and escape their worst violence.

"On deck," we are told,* "there was only one solitary individual looking out to give the alarm, in the event of the ship breaking from her moorings. The seamen on watch continued only two hours; he who kept watch at this time was a tall, slender man of a black complexion; he had no great-coat nor over-all of any kind, but was simply dressed in his ordinary jacket and trousers; his hat was tied under his chin with a napkin, and he stood aft the foremast, to which he had lashed himself with a gasket, or small rope round his waist, to prevent his falling upon deck or being washed overboard. When Mr. Stevenson looked up he appeared to smile, which afforded a further symptom of the confidence of the crew in their ship."

About six o'clock in the evening the gale abated, and the sun rose the next morning in a comparatively serene sky. The waves still rolled very heavily, and at the Bell Rock they threw up their spray in columns of from forty to fifty feet in height. When Mr. Stevenson was

* Stevenson, "Account of the Bell Rock Lighthouse," p. 157.

able to visit the rock, he found abundant evidence of their force: six large blocks of granite had been removed from their places and flung over a rising ledge into a hole some twelve or fifteen paces distant. The ash-pan of the smith's forge, with its weighty cast-iron back, had also been washed from their places of supposed security; the chain of attachment had been broken, and these ponderous articles were found on the very opposite side of the rock.

Such incidents as these stimulated Stevenson's desire to complete the erection of the beacon, which would serve as a warning to the mariner, and as an asylum for the artificers on the rock. By dint of persevering exertions, it was at length completed; and soon afterwards, on the 6th of October 1807, the works were relinquished for the season. Though only about one hundred and thirty-three hours had been actually devoted to them, enough had been effected to afford an example of what may be accomplished under similar circumstances, when every heart and hand labour with conscientious zeal; for the artificers had wrought at the construction of the beacon as if for life, or like men stopping a breach in a wall to repress the inroads of a destroying flood.*

During the winter the men were engaged in quarrying and preparing the stones, and collecting divers materials. The stones were laid down in courses in the positions they would occupy in the future lighthouse; they were then carefully numbered and marked, bored or fixed with oaken trenails and stone joggles, after the plan adopted

* Stevenson, "Account of the Bell Rock Lighthouse," p. 180.

by Smeaton in building the Eddystone lighthouse; and in this state laid aside for trans-shipment to the rock.

The operations of the second season (1808) were commenced at as early a date as the weather permitted. A new tender, the *Sir Joseph Banks*, was provided for the reception of the men when not at work, and as it lay alongside the rock, protected from the winds, the process of landing or embarkation was conducted with very great facility.

The mode in which the different artificers were employed is thus described by Mr. Stevenson* :—

"Preparations having been made for a second forge upon the beacon, the smiths commenced their operations both upon the higher and lower platforms, where forges had been erected. They were employed in sharpening the picks and irons for the masons, and in making *bats*, movable cranes, and other apparatus of various descriptions connected with the railways. The landing-master's crew were occupied in assisting the mill-wrights in laying the railways to land. Sailors, of all descriptions of men, are the most accommodating in the use of their hands. They worked freely with the boring irons, and assisted in all the operations of the railways, acting by turns as boatmen, seamen, and artificers. We had no such character on the Bell Rock as the common labourer. All the operations of this department were cheerfully undertaken by the seamen, who, both on the rock and on shipboard, were the inseparable companions of every work connected with the erection of the Bell Rock Lighthouse. It will

* Stevenson, "Account of the Bell Rock Lighthouse," pp. 222, 223.

naturally be supposed, that about twenty-five masons, occupied with their picks in executing and preparing the foundation of the lighthouse, in the course of a tide of about three hours, would make a considerable impression upon an area even of forty-two feet in diameter. But in proportion as the foundation was deepened, the rock was found to be much more hard and difficult to work, while the baling and pumping of water became much more troublesome. A joiner was kept almost constantly employed in fitting the picks to their handles, which, as well as the points of the irons, were very frequently broken. At eight o'clock the water overflowed the site of the building, and the boats left the rock with all hands for breakfast."

The appearance of the rock at this time was very curious, and with its effects of light and shade would have pleased the eye of a Rembrandt. Its surface was thronged with men; the two forges flamed, one above the other, like Cyclopean furnaces; while the anvils thundered with the rebounding clash of their wooden supports, in strange contrast with the noisy clamour of the ocean-surge. During the night, if the men were at work, the spectacle presented to a passing vessel was of the most picturesque character. To the artificers themselves, the effect of extinguishing the torches was sometimes startling, and made terrible the darkness of the night; while the sea, lit up with a phosphoric glow, rolled in upon the rock like waves of fire.

As the enterprise proceeded, the smiths were sometimes left on the beacon throughout the day, and the din of their anvils formed, in foggy weather, an excellent guide for the boats. This circumstance confirmed Mr. Stevenson's opinion as to the propriety of erecting in the lighthouse large bells to be rung by machinery, and tolled day and night during the continuance of hazy weather, so as to prevent the mariner from drawing too near the dangerous rock.

So much progress had been made in the preliminary operations by the 10th of July, that on that day it was determined to lay the foundation-stone. The ceremony attending it was very simple. Mr. Stevenson, attended by his three assistants, applied the square, the level, and the mallet in due form, and pronounced the following benediction :—" May the Great Architect of the Universe complete and bless this building!" Three earnest cheers were then given, and success to the future operations was drunk with the greatest enthusiasm.

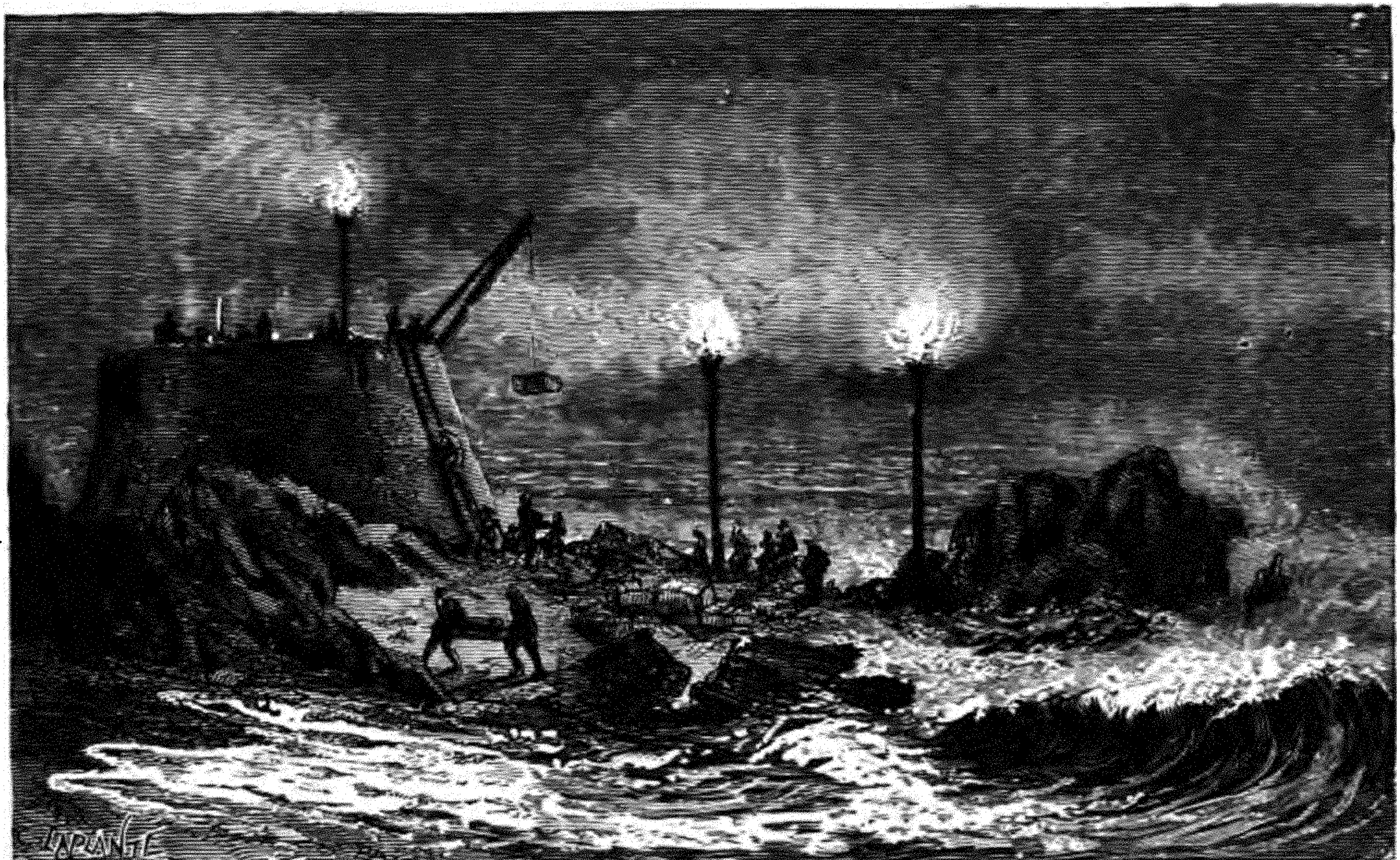
The first course of masonry was now laid down. It was only one foot in thickness, yet it contained 508 cubic feet of granite in outward casing; 8076 cubic feet of Mylnefield stone in the hearting; 104 tons of solid contents; 132 superficial feet of hewing in the face-work; 4519 superficial feet of hewing in the beds, joints, and joggles; 420 lineal feet boring of trenail holes; 378 feet lineal cutting for wedges; 246 oaken trenails; 378 oak wedges in pairs.

By the end of the season the lighthouse was raised to a level with the highest part of the margin of the foundation-pit, or about 5½ feet above the lower bed of the foundation-stone. Work was discontinued on the 21st of September.

Months rolled away, and the third season in due time came round. The artificers resumed their building operations, in 1809, on Saturday, the 27th of May; and in spite of various accidents and delays, and considerable obstruction from the inclemency of the weather, had so far progressed by the end of June as to be able to continue their labours on the masonry while the rock was under water. On the 8th of July, it was remarked, with no small demonstrations of joy, that the tide (a neap one) ceased for the first time to overflow the building at high-water. Flags were accordingly hoisted at every vantage-point, as well as on board the yacht, the tender, the stone-praams, and the floating light; a salute of three guns was fired; and, we need hardly say, the loudest and heartiest cheers pealed through the air and mingled with the music of the waves.

It is unnecessary to follow, step by step, the operations of Stevenson and his "undaunted band." Such details would possess no interest for the general reader; but he will understand how great must have been the skill and perseverance of the engineer, how arduous the industry of all engaged, when we record that by the 25th of August the solid part of the building had been raised to the height of 31½ feet above the rock, and of 17 feet above high-water of spring tides.

Having during two seasons landed and built up more than one thousand four hundred tons of stone, while the work was low down in the water, and before the beacon had been rendered inhabitable, and as not more than seven hundred tons were required to complete the masonry, Mr. Stevenson had good reason to conclude that another season



THE BUILDING OF THE BELL ROCK LIGHTHOUSE.

would consummate his enterprise. But the success of the work absolutely depending on the stability of the beacon, he paid frequent visits to the rock in the course of the winter, to see that it braved unhurt the fury of winds and waves.

The operations of the fourth and last season were commenced on the 10th of May. The artificers took permanent possession of the beacon, which consisted at this time of three floors—one occupied as the cook-house and provision store; the second divided into two cabins, one for the engineer and the other for the foreman; and the third provided with three rows or tiers of beds, capable of accommodating about thirty men. Below these three floors was a temporary floor, at the height of twenty-five feet above the rock, used for preparing mortar, and for the smith's workshop. The beacon was connected with the lighthouse by a bridge of timber.

The apartment which Mr. Stevenson himself occupied he has described in characteristic language.

It measured, he says, not more than four feet three inches in breadth on the floor; and though, from the oblique direction of the beams of the building, it widened towards the top, yet it did not admit of the full extension of his arms when he stood on the floor; while its length was little more than sufficient for suspending a cot-bed during the night. This was tied up to the roof during the day, leaving free room for the admission of occasional visitants. His folding-table was attached with hinges immediately under the small window of the apartment, and his boots, barometer, thermometer, portmanteau, and two or three camp-stools, formed the bulk of his movables. His diet being plain, the paraphernalia of the table were proportionately simple; though everything had the appearance of comfort, and even of neatness, the walls being covered with green cloth, formed into panels with red tape, and his bed festooned with curtains of yellow cotton-stuff. If, in speculating upon the abstract wants of man in such a seclusion, one were reduced to a single book, the Sacred Volume, whether considered for the striking diversity of its story, the morality of its doctrines, or the important truths of its gospel, would have proved by far the greatest treasure.

In the early part of July, a visit was paid to the works by Mrs. Dickson, the only daughter and surviving relative of Smeaton, the great engineer. She was conveyed to the rock on board the *Smeaton* tender, which had been so named by Stevenson from a sense of the deep obligation he owed to the labours and abilities of his predecessor. It is unnecessary to say that she was exceedingly gratified by her visit.

Passing over the daily details of the work, we arrive at the 29th of July, as one of the epoch days of the undertaking. The *last stone* was landed on the Bell Rock, and you may be sure such an occasion was duly celebrated. On the 30th, the *last course* (the 90th) of the building was laid, finishing the exterior wall, and the engineer then solemnly pronounced a suitable benediction: "May the Great Architect of the Universe, under whose blessing this perilous work has prospered, preserve it as a guide to the mariner!"

BELL ROCK LIGHTHOUSE.

With the minute particulars recorded by Stevenson of the completion of the interior of the building, it is needless to weary the reader. Their technicalities would puzzle him, and in their prolonged detail we can find nothing to excite his interest. He will understand that Stevenson neglected nothing which could ensure the safety and efficiency of his structure, and on the 17th of December 1810, the following advertisement intimated to the public that his enterprise had been successful, and that thenceforth the perils of the Bell Rock would virtually cease to exist:—

"A lighthouse having been erected upon the Inch Cape, or Bell Rock, situated at the entrance of the Firths of Forth and Tay, in north latitude 56° 29′ and west longitude 2° 22′,—The Commissioners of the Northern Lighthouses hereby give notice, that the light will be from oil, with reflectors, placed at the height of about 108 feet above the medium level of the sea. The light will be exhibited on the night of Friday, the 1st day of February 1811, and each night thereafter, from the going away of daylight in the evening until the return of daylight in the morning. To distinguish this light from others on the coast, it is made to revolve horizontally, and to exhibit a bright light of the natural appearance, and a red-coloured light alternately, both respectively attaining their greatest strength, or most luminous effect, in the space of every four minutes; during that period the bright light will, to a distant observer, appear like a star of the first magnitude, which after attaining its full strength is gradually eclipsed to total darkness, and is succeeded by the red-coloured light, which in like manner increases to full strength, and again diminishes and disappears. The coloured light, however, being less powerful, may not be seen for a time after the bright light is first observed. During the continuance of foggy weather, and showers of snow, a bell will be tolled by machinery, night and day, at intervals of half a minute."

It was found that this light could be clearly seen and recognized, in fair weather, at a distance of seven leagues.

The Bell Rock Lighthouse, thus happily completed, is a circular building, 42 feet in diameter at the base, and 13 feet at the top. The masonry is 100 feet high, and the whole structure, including the light-room, 115 feet. From the entrance door, a circular stair leads to the first apartment, which is used as a store-room. Wooden steps ascend to the other apartments, which are appropriated to the light-keepers, and to the appurtenances of the lighting apparatus. The light-room, which is formed of cast iron, and glazed with polished glass, is octagonal in shape, 12 feet in diameter, and 15 feet in height. It is covered with a dome, and terminates in a ball.

The manner in which this noble structure braves the assault of waters has been graphically described by Mr. Stevenson. It is during the winter's storms, he says, and when viewed from the Forfarshire coast, that it appears in one of its most interesting aspects, standing proudly among the waves, while the sea around it is in the wildest state of agitation. The light-keepers do not seem to be in motion, but the scene is by no means still, as the clang and clamour, the motion and fury of the waves, are incessant. The seas rise in the most surprising fashion to the height of about seventy feet above the rock, and after expending their force in a perpendicular direction, fall in foaming masses round the base of the lighthouse, while considerable portions of the spray seem to adhere, as it were, to the building, and gather down its sides in the condition of froth as white as snow. Some of the great waves burst and are expended upon the rock before they reach the lighthouse; while others strike the base, and embracing the walls, meet on the western side, where the violent collision churns the eddying waters into the wildest foam.

The management of the Bell Rock lighthouse is provided for as follows:—The nearest town is Arbroath, about eleven miles distant, where a cutter called the *Pharos* is stationed as the lighthouse tender. Once a fortnight, or in the course of each set of spring-tides, she visits the rock, to relieve the light-keepers and replenish their store of provisions and fuel. The keepers are four in number, three of whom are always on duty, while one is ashore. If the weather be favourable, each light-keeper is six weeks on the rock, and a fortnight on land with his family. The pay is from £50 to £60 per annum, with a stated allowance of bread, beef, butter, oatmeal, vegetables, and small beer, and fourpence a day extra for tea. A suit of uniform is also provided once in three years.

The watches in the light-room are relieved with as much punctuality as on board a man-of-war, no keeper being allowed to leave until his successor presents himself, under the penalty of immediate dismissal. To ensure the strictest regularity in this respect, a timepiece is placed in each light-room, and bells are hung in the bed-rooms of the dwelling-houses, which, being connected by mechanical appliances with the lighthouse, can be rung as necessity requires.

At Arbroath, as at other stations, the light-keepers' dwellings are very neatly built and comfortably arranged, each having its little garden attached. There are also suitable storehouses provided, a room for the master and crew of the lighthouse tender, and a signal-tower fifty feet high, on whose summit a small observatory is erected, with an excellent achromatic telescope, a flag-staff, and a copper signal-ball measuring eighteen feet in diameter. A similar ball crowns the lighthouse dome, and by these means daily signals are exchanged, to signify that all is well. Should the ball at the top be allowed to remain down, as is the case when particular supplies are needed, or either of the light-keepers have been seized with illness, assistance is immediately dispatched in the tender.

The total cost of the lighthouse, of the buildings at Arbroath, of the tender, and the first year's stores, was £61,350.

A curious accident is recorded in connection with the lighthouse as having occurred on the 9th of February 1832, about ten o'clock P.M.

A large herring-gull flew against one of the south-eastern mullions of the light-room with so much violence that two of the polished plates of glass, measuring each about two feet square and a quarter of an inch thick, were dashed to atoms, and scattered over the floor, to the great alarm of the keeper on watch, and of his two associates, who rushed instantly into the light-room. It happened, fortunately, that although one of the red-shaded sides of the reflector-frame was passing in its revolution at the moment, the fragments were so minute that no injury was done to the valuable red glass. The gull was found to measure five feet from tip to tip of its expanded wings. A large herring was found in its gullet, and in its throat a piece of plate glass about an inch in length.*

Before quitting the subject of the Bell Rock Lighthouse, it is desirable we should refer to another of Mr.

* "Smeaton and Lighthouses," p. 97.

Stevenson's achievements, the Beacon on the Carr rock. The Carr is the seaward extremity of a sunken reef, visible only at low water, which extends about two miles from the shore of Fifeness, on the northern side of the mouth of the Forth estuary. Its position is unusually dangerous, as it lies in the track of shipping ascending and descending Scotland's great eastern river. In the course of nine years it proved fatal to no fewer than sixteen vessels. As all attempts had failed to mark its position by a floating buoy, the authorities resolved to erect a beacon of masonry upon it, and in 1813 the difficult work was commenced under Mr. Stevenson's direction. The dimensions of the Carr are only 23 feet in breadth by 15 feet in length, and it was impossible, therefore, to obtain a base for a building of greater diameter than 18 feet.

Five seasons were spent in the erection of the beacon, so many were the obstacles which the workmen had to conquer, especially from the prevalence of rolling seas and stormy winds. In the fifth year, when the whole of the masonry had been completed, a November hurricane swept away the upper part of the structure. A modification of the original design was then adopted; and on the courses of masonry left intact by wind and waves six columns of cast iron were planted, terminating in a cast iron ball of three feet in diameter, which rose about twenty-five feet above the average sea-level. The whole was completed in the sixth season (September 1821). *

The Carr rock is about six miles north-north-east of the Isle of May lighthouse, and twelve miles south-west of the Bell Rock.

* Stevenson's "Account of the Bell Rock Lighthouse," pp. 52–57.

In a recent pamphlet,* Mr. Thomas Stevenson, the engineer to the Board of Northern Lights—who has an hereditary as well as an individual claim to be heard on all matters of this kind—has suggested various modes of lighting beacons and buoys. As he observes, the importance of raising them to the rank of illuminated night-marks must be apparent to all who know anything of coast navigation; and he is certainly justified in thinking that the subject is worthy of more attention than has hitherto been given to it.

He speaks, in the first place, of *apparent* or *borrowed lights*, where a ray is thrown on a buoy or beacon—as in the case of the Arnish Rock, referred to on page 274,—from a neighbouring lighthouse. The only other existing example of an apparent light is to be found at the harbour of Odessa, in the Black Sea. It was constructed in 1866, and is situated three hundred feet from the shore.

Mr. Stevenson's next suggestion applies to *dipping lights for sunk rocks*, where it would be difficult or impossible to erect a beacon for containing the necessary optical apparatus. Here he would so arrange the lamp and reflectors of the lighthouse as to dip vertically, and thus project a cone of rays upon the sea for a considerable area round the secret danger. On seeing the illuminated wave-space the mariner would alter his course, and give the sunken rock a "wide berth."

The other methods proposed by Mr. Stevenson are:—

The conduction either of voltaic, magnetic, or frictional electricity, singly or combined, to the buoy or beacon, through wires, submarine, or, where practicable, suspended in the air, so as to produce a spark either with or without

* Stevenson, "Proposals for the Illumination of Beacons and Buoys" (ed. 1870).

vacuum tubes, or by means of an electro-magnet and the deflagration of mercury.

The conduction of gas from the shore in submarine pipes.

Self-acting electrical apparatus, produced by the action of sea-water or otherwise at the beacon itself, so as to require no connection with the shore.

And, finally, Mr. Stevenson recommends different applications of sound, so as to produce distinct and powerfully audible warnings during the prevalence of a thick fog or mist :—

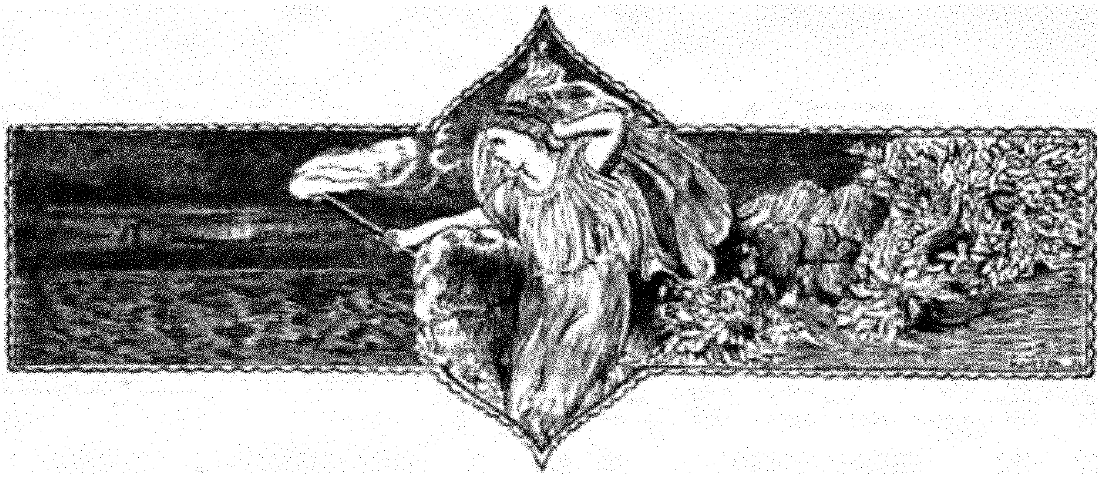
The propagation of sound during fogs through pipes communicating with the shore,* or the origination of sound at the beacon or buoy itself, by condensing the column of air, or by acting on a column of water contained in the pipe.

Bells rung by electricity. Mr. Wilde, of Manchester, states that bells twelve or eighteen inches in diameter, placed on different beacons, and as far off as ten miles from the shore, could be tolled a hundred times a-minute by means of a three and a half or four inch electro-magnetic machine worked by an engine of about two-horse power.

And, finally, bells may be rung by the simple pressure of the waves through the agency of a float, which would sink or rise according as the tide sunk or rose. This was proposed for the beacon at the Carr Rock by the late Mr. Stevenson in 1810.

By the adoption of one or other of these suggestions, according to the conditions of the locality, there can be no doubt that the subsidiary illumination of our shores and their contiguous waters would be very considerably improved.

* In one of the Paris water-pipes, 3120 feet long, M. Biot was able to keep up a conversation, in a very low tone, with a person at the other end.



CHAPTER IV.

THE SKERRYVORE LIGHTHOUSE.

THE full details which we have given of the erection of the Bell Rock Lighthouse will render unnecessary any elaborate account of the mode of construction of later edifices. There are some, however, which we are unwilling to pass over without at least a cursory notice, owing either to their romantic position or to their special interest as examples of engineering skill. One of the most important of these is the Lighthouse of the Skerryvore, situated on a reef which, in all leading features, is a counterpart of the Bell Rock. It is placed in the same parallel of latitude, and occupies the identical position on the west coast of Scotland which the latter occupies on the eastern. Nor was it of old less fatal or less ominous to the mariner, but annually exacted its tribute of precious lives and wrecked vessels. A few minutes sufficed for the total loss of any unfortunate ship which dashed against the gneiss crags of the Skerryvore, and its rent and shattered timbers were quickly carried by the tide to the fishermen of the island of Tyree. Not that this formidable memorial of past volcanic convulsions was totally submerged — some of its higher points rose above the level of the highest tides: but the extent of its foundations was considerable; and even in the summer season latent dangers beset the difficult channel between its eastern extremity and the island of Tyree, which lies about eleven miles distant.*

For various reasons the attention of the Commissioners of Northern Lights had been early directed to this formidable reef; and in 1814 they had determined to mark its locality by the erection of a lighthouse. It was visited in this same year by some of the members of the Commission, accompanied by one whose name alone is sufficient to render the visit ever memorable — Sir Walter Scott. He was much struck with the desolateness of the situation, which he thought infinitely surpassed that of the Bell Rock or the Eddystone.

Owing, perhaps, to the difficulty of the enterprise, it was deferred until the autumn of 1834, when Mr. Alan Stevenson was authorized to commence a preliminary inspection, which he did not complete until 1835. This difficulty proceeded not only from the position, but from the nature of the reef itself.

It is true that the distance from the mainland was three miles less in the case of Skerryvore than in that of the Bell Rock; but the barren and over-populated island of Tyree did not offer the resources of the eastern coast, nor a safe and commodious port like that of Arbroath. The engineers were therefore compelled to erect, at the nearest and most favourable point of Tyree, a quay and a small harbour, with temporary cabins for the workmen, and

* Alan Stevenson, "Account of the Skerryvore Lighthouse" (ed. 1848), p. 41.

storehouses of every kind; all whose materials, excepting only stone—and even the supply of *that* failed after awhile—required to be transported from distant parts.

The first and most embarrassing, perhaps, of the numerous questions which present themselves to the engineer when entering upon the construction of a lighthouse, are those of the *height* and the *mass*. In the days of Smeaton, when the best light in use was that of common candles, the elevation beyond a certain point could not be of any utility; while in 1835 the application of the reflector and the lens, by assisting in the extension and diffusion of the light, rendered, on the contrary, a considerable elevation both necessary and desirable.

It was therefore decided that the height of the Skerryvore should be 135 feet above the highest tides, so as to command a horizon visible for a radius of eighteen miles. The diameter of the base was fixed at 42 feet, and that of the topmost story at 16 feet; consequently the masonry of the tower would be double that of the Bell Rock, and four and a half times that of the Eddystone.

Another peculiarity distinguishes the Skerryvore from the Bell Rock. The sandstone of the latter is wave-worn, and broken up into a thousand rugged inequalities: the action of the sea on the igneous formation of the Skerryvore has, on the contrary, communicated to it the appearance and polish of a mass of dark-coloured crystal. It is so compact and smooth that the foreman of the masons, when he landed on it, said it was like climbing up the neck of a bottle. Moreover, notwithstanding its durability, the gneiss of Skerryvore is excavated into caverns, which considerably limit the area adapted for building operations. One of these caverns, we are told, terminates in a narrow spherical chamber, with an upper opening; through which, from time to time, springs a bright, luminous shaft of water, 20 feet high, and white as snow, except when the sun wreathes it with a thousand rainbows.

Mr. Alan Stevenson commenced actual operations in 1838 by the erection of a provisional barrack on piles, at such a height as to be beyond the reach of all average tides. This was designed to shelter the men at night, saving them the voyage to and from the mainland; and also to accommodate them when their work was suspended by bad weather. The first erection was swept away in a great gale on the night of November 3; but happily the labours of the season were then ended, and there were no occupants. On this occasion the grindstone was deposited in a hole 36 feet deep; the iron anvil was transported 13 yards from the place where it had been left; the iron stanchions were bent and twisted like corkscrews; and, finally, a stone weighing half a hundred-weight, lying at the bottom of an excavation, was carried to the highest surface of the rock.

Conquering all feelings of discouragement, Mr. Stevenson, in the following year, renewed his operations. A second barrack was completed by the 3rd of September. It was built of timber, and consisted of three stories: the first was appropriated as a kitchen; the second divided into two cabins, one for the engineer and one for the master of the works; and the third belonged to the thirty workmen engaged in the erection of the lighthouse.

A more remarkable habitation than this was never dwelt in by human beings. It was an oasis in a wide waste of waters—a rude asylum suspended between sea and sky. Perched forty feet above the wave-beaten crag, Mr. Stevenson, with a goodly company of thirty men, in this singular abode, spent many a weary day and night at those times when the sea prevented a descent to the rock; anxiously looking for supplies from the shore, and earnestly longing for a change of weather favourable to the recommencement of the works. For miles around nothing could be seen but white foaming breakers, and nothing heard but howling winds and lashing waves.

In the erection of the lighthouse itself, the first important operation, and one which occupied the whole of the season of 1839—from the 6th of May to the 30th of September—was the excavation of a suitable foundation. When building the Eddystone, Mr. Smeaton had been compelled to take into consideration the peculiar structure of the rock, and to adapt his lower courses of masonry, as we have seen, to a series of gradually ascending terraces formed by the successive ledges of the rock itself. This difficult and expensive process was rendered unnecessary by the geodesical formation of the Skerryvore. Mr. Stevenson, therefore, began work by hollowing out a base of forty feet diameter—the largest area he could obtain without any change of level. This portion of his enterprise occupied twenty men for two hundred and seventeen days; two hundred and ninety-six charges of gunpowder were made use of; and two thousand tons of debris and refuse were cast into the sea. The mining or blasting operations were not carried on without great difficulty, on account of the absence of any shelter for the miners, who were unable to retire more than ten or twelve paces, at the furthest, from the spot where the charge was fired. The quantities of gunpowder, therefore, were measured with the utmost nicety; a few grains too many, and the whole company of engineers and workmen would have been blown into the air. Mr. Stevenson himself generally fired the train, or it was done under his superintendence and in his presence; and from the precautions suggested by his skill and prudence, happily no accident occurred.

During the first month of their residence in the barrack, he informs us * that he and his men suffered much inconvenience from the inundation of their apartments. On one occasion, moreover, they were a fortnight without receiving any communication from the mainland, or from the steam-tug attached to the works; and during the greater part of this time they saw nothing but white plains of foam spreading as far as the eye could reach, and the only sounds were the whistling of the wind and the thunderous roar of the billows, which ever and anon swelled into such a tumult that it was almost impossible to hear one another speak. We may well conceive that a scene so awful, with the ruins of their first barrack lying within a few feet of them, was calculated to fill their minds with the most discouraging apprehensions. Mr. Stevenson records, in simple but graphic language; the indefinite sensations of terror with which he was aroused one night when a tremendous wave broke against the timber structure, and all the occupants of the chamber

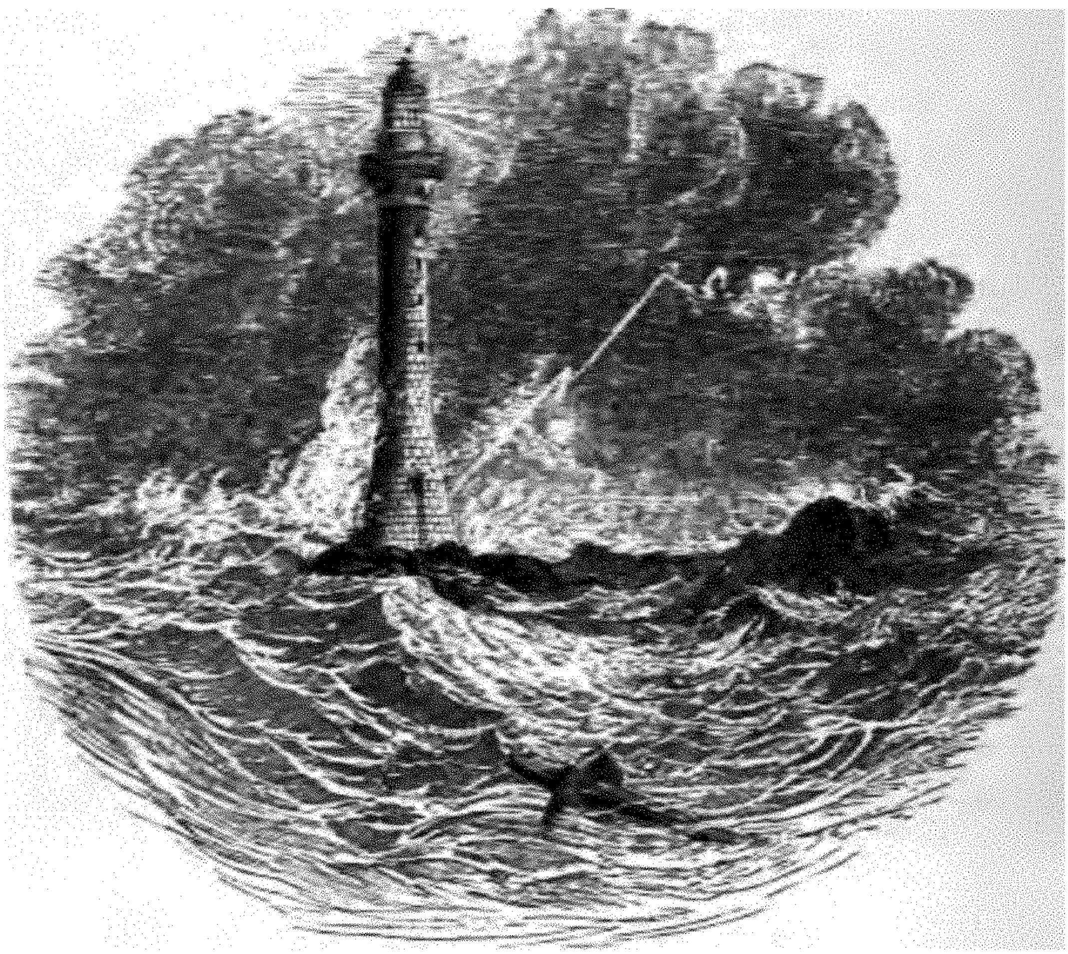
* A. Stevenson, "Account of the Skerryvore Lighthouse," p. 143.

beneath him involuntarily uttered a terrible cry. They sprang from their beds in the conviction that the whole building had been precipitated to the depths of ocean.

Up to the 20th of June no materials had been landed on the rock but iron and timber; next arrived the great stones, all ready cut and hewn, and weighing not less than eight hundred tons. But the disembarkation of these very essential supplies entailed serious risks, which were renewed with every block, for the loss of a single one would have delayed the works. At length the foundation-stone was fixed in its place; the Duke of Argyle presiding over the ceremony, accompanied by his duchess, his daughter, and a numerous rétinue.

The summer of 1840 was a summer of tempests. Nevertheless, in the midst of incessant fears, and dangers, and wearying accidents, and every kind of privation, the devoted band of workers prosecuted their noble enterprise; and such, says Mr. Stevenson, was their profound sense of duty—such the desire of every one that full and complete success should crown their efforts—that not a man expressed a wish to retreat from the battle-field where he was exposed to so many enemies.

The day's occupations were thus divided. At half-past three in the morning they were awakened, and from four o'clock to eight they laboured without a pause; at eight they were allowed half an hour for dinner. Work was then resumed, and continued for seven or eight, or, if it were very urgent, even for nine hours. Next came supper, which was eaten leisurely and comfortably in the cool of the evening. This prolonged toil produced a continual



SKERRYVORE LIGHTHOUSE.

sleepiness, so that those who stood still for any time invariably fell off into a profound slumber; which, adds Mr. Stevenson, frequently happened to himself during breakfast and dinner. Several times, also, he woke up, pen in hand, with a word begun on the page of his diary. Life, however, on the desert rock of the Skerryvore seems not to have been without its peculiar pleasures. The grandeur of ocean's angry outbursts—the hoarse murmur of the waters—the shrill harsh cries of the sea-birds who incessantly hovered round them—the splendour of a sea polished like a mirror—the glory of a cloudless sky—the solemn silence of azure nights, sometimes sown thick with stars, sometimes illuminated by the full moon,—were scenes of a panorama as novel as it was wonderful, and which could not fail to awaken thought even in the dullest and most indifferent minds. Consider, too—when we think of Mr. Stevenson and his devoted company—the continual emotions which they experienced of hope and anxiety; the necessity, on the part of their leader, of incessant watchfulness, and of readiness of resource to grapple with every difficulty; the gratification with which each man regarded the gradual growth, under his laborious hands, of a noble and beneficent work; and we think the reader will admit that life upon the Skerryvore, if it had its troubles and its perils, was not without its rewards and happiness.

In July 1841 the masonry had been carried to an elevation which rendered impossible the further employment of the stationary crane. As a substitute the balance crane was introduced—that beautiful machine, invented at the Bell Rock, which rises simultaneously with the edifice it assists to raise.

Thanks to this new auxiliary, the mass of masonry completed in the season of 1841 amounted to 30,000 cubic feet, more than double the mass of the Eddystone, and exceeding that of the Bell Rock lighthouse. Such was the delicate precision observed in the previous shaping and fitting of the stones, that after they had been regularly fixed in their respective places, the diameter of each course did not vary one-sixth of an inch from the prescribed dimensions, and the height was only one inch more than had been determined by the architect in his previous calculations.

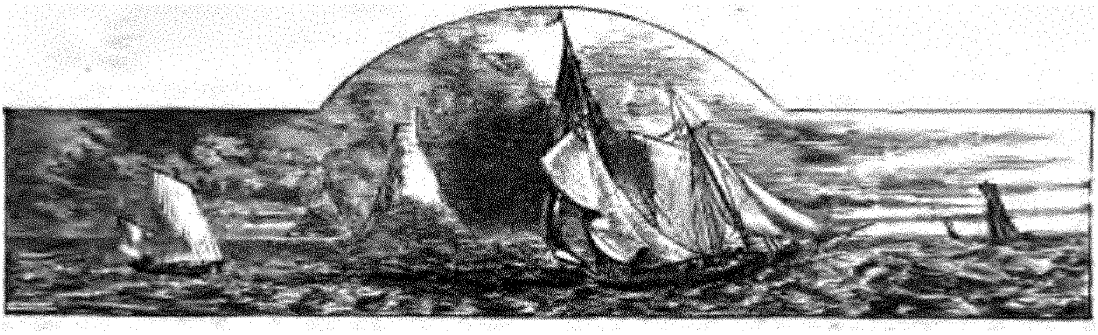
On the 21st of July, the steamer saluted with its one gun the disembarkation of the last cargo of stones intended for the lighthouse. On the 10th of August the lantern arrived, which was hauled up to its position, and duly fixed; a temporary shelter from the weather being also erected for it.

The summer of 1843 was devoted to pointing the external masonry—a wearisome operation, conducted by means of suspended scaffolds—and to the completion of the internal arrangements. And at length, on the 1st of February 1844, the welcome light of the Skerryvore pharos blazed across the waters of the stormy sea.

The illuminating apparatus adopted was the dioptric, and identical in all respects with the apparatus supplied a few years before to the Tower of Cordova. It is a revolving light, whose full brilliancy is apparent only once in a minute. Elevated 150 feet above the sea level, it is visible at a distance of eighteen miles.

Such is the stirring history of the Skerryvore lighthouse. The reader will think, perhaps, that it differs but little from that of the Bell Rock and the Eddystone. Nevertheless we could not pass over it in silence, for it completed a work which may fitly be called "the art of building lighthouses in the open sea"—an art entirely unknown before the days of Smeaton, and Robert and Alan Stevenson—three men of whom Ocean, if it could translate into words the "rhythmical smile" of its summer calm, or the harsher accents of its equinoctial wrath, might say with the poet,—

"Great I must call them, for they conquered me!"



CHAPTER V.

NORTH UNST, 1854. SUNDERLAND, 1841.

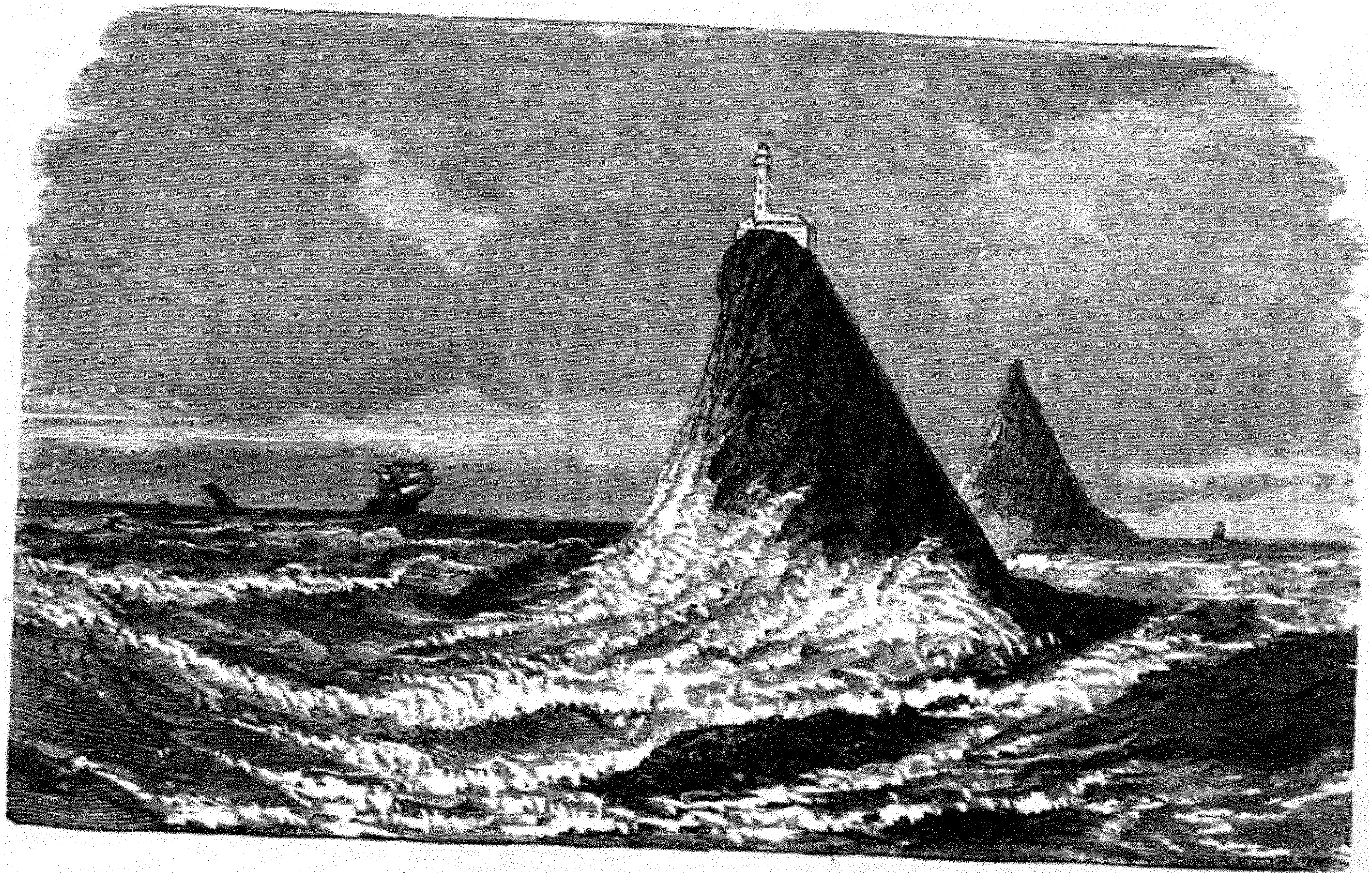
THE erection of the North Unst tower, completed in 1854, offered no difficulties comparable to those which tested the skill and perseverance of the builder of the Bell Rock; yet, not the less, it is interesting as one of the most important results obtained by our English engineers. As our illustration shows, it stands rooted on an isolated reef, near the Shetland Isles, whose elevation above the sea is estimated at 200 feet.

Its northern front is almost perpendicular, and exposed to the most violent assaults of Ocean; on the south the declivity is less abrupt, but scarcely easier of access; and its summit is only of breadth sufficient to receive the foundation of the tower. This is 50 feet in height, and contains, besides the light-room, a sleeping chamber, a kitchen, and a store-room. At its base is built an additional store-room for the supplies of oil, charcoal, and fresh water. It is only accessible in fine weather.

The North Unst lighthouse is provided with a staff of four keepers, whose habitations are situated on the island of Unst (one of the Shetland group), about four miles distant.

It has justly been said that one of the strangest operations recorded in the history of lighthouses is, undoubtedly, the work undertaken and successfully accomplished at Sunderland in 1841. Some important improvements had been effected in its harbour; and a jetty had been constructed which rendered useless the old pier, and the lighthouse built upon it. Consequently, preparations were made for the demolition of the latter. An engineer, of the name of Murray, however, conceived the idea of transporting the monument, in one piece, to the intended site of the new lighthouse, a distance of about 475 feet. His proposal was favourably received; for the removal of great masses of masonry, in Europe at least, is an enterprise which always excites a very general curiosity. In the United States, that "go-ahead" land of bold projects and daring inventions, such enterprises are more frequent, and the process has been several times applied to houses (as recently at Chicago) and factories, for which it was desirable to secure a more convenient or a securer site. In such cases a series of openings is made in the walls, and through these openings beams are introduced, united together by cross beams so as to form a kind of flooring; then the lowest part of the base of the walls is destroyed, leaving the building to rest upon the timber platform, which is afterwards set in motion by a system of grooves.

So far as concerned the Sunderland lighthouse, the enterprise was much more arduous; for its narrow base supported a burden relatively more considerable than that of a house, and one which apparently must crush all machines interposed between it and the ground. The weight of the lighthouse was 757,000 lbs.; it consisted



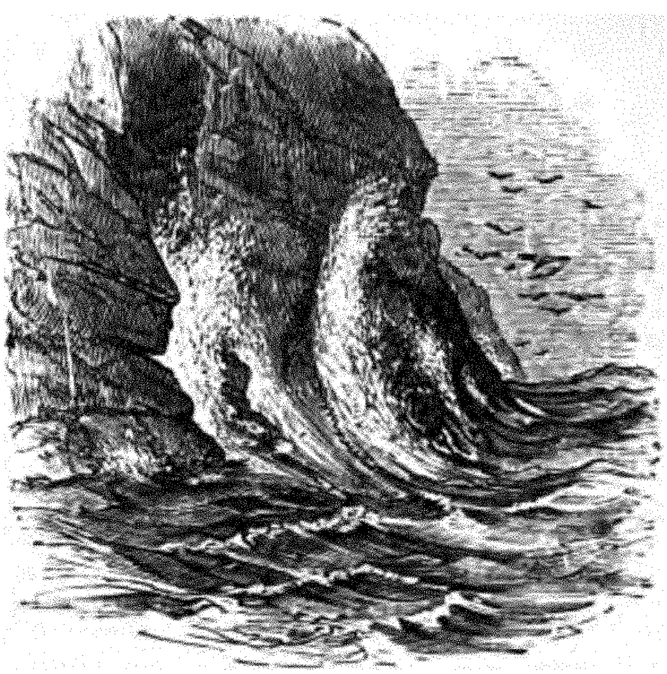
NORTH UNST LIGHTHOUSE.

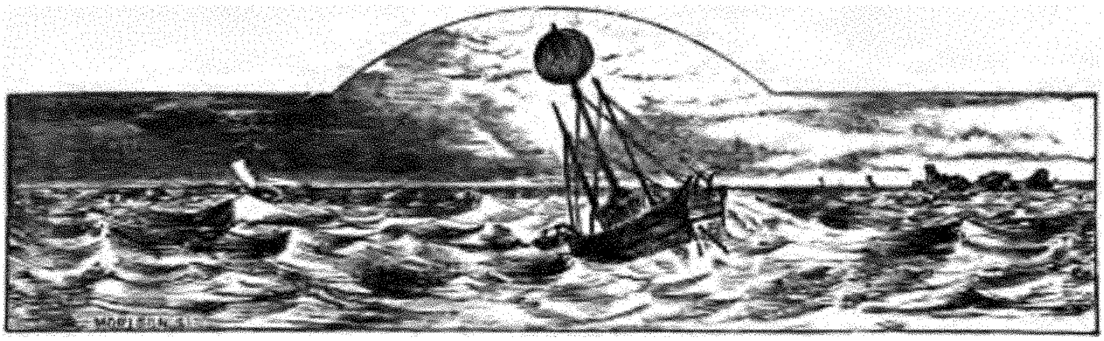
of an octagonal tower 64 feet high, and 15 feet in diameter at the base. We must add that the new pier was 19 inches higher than the old, and that its direction was entirely different; which rendered it necessary that the building should be turned upon its axis, at the same time that it had to traverse a broken line, one of whose sections, from north to south, measured 28 feet, and the other, from west to east, 447 feet.

The accompanying illustration will afford an idea of the manner in which this difficult engineering problem was solved. By means of a series of openings made in the base of the tower, as above described, the latter was raised on a solid platform of oaken planks; while it was surrounded from base to summit by a framework of stays or props, strengthened by cross beams. The platform rested on one hundred and forty-four cast-iron wheels, grooved like those of a locomotive, and running on eight parallel rails, likewise of cast-iron, which, with their "sleepers," were laid along the masonry of the pier and jetty. When the mass had moved a few feet, the rails were lifted, and laid down again in front of the machinery, and this process was repeated until the new site of the lighthouse was reached. Iron chains attached to the platform were wound upon windlasses, worked by a band of sturdy labourers.

The various stages of the operation were accomplished in thirteen hours and twenty four minutes. The combined efforts of forty men were required for five hours to carry the apparatus over the 28 feet of the first section, while eighteen men sufficed to carry it in eight hours and twenty-four minutes over the 447 feet of the second.

In this latter part the rails were at first laid down on a curve, so as to bring the pharos into a symmetrical position with the jetty, then it advanced parallel to itself, following a slightly inclined plane. It was prevented by wedges from deviating during this ascent from a perpendicular line. The object of this twofold disposition was to veer the pharos round, and to raise it to a higher level—which, as we have seen, was an indispensable condition. The removal was eventually accomplished with so much success, and so little interruption to the business of the harbour, that the lamp was lighted in the evening at the usual hour.





CHAPTER VI.

LIGHTHOUSES ON THE ENGLISH COAST.

We propose, in the present chapter, to glance at a few of the best known pharoses which illuminate our home-waters, but without observing any particular order. Our description of each will be brief, for it is needless to say that, as a rule, lighthouses closely resemble one another in their principles of construction as in their general arrangements, and that the differences between them are simply matters of detail.

Upon *Needles Point*, the westernmost extremity of the Isle of Wight, at an elevation of 474 feet, a lighthouse was erected early in the last century. Notwithstanding its great height, it is recorded that its windows were sometimes shattered by stones flung up by the mounting and raging billows.* It had ten Argand lamps, and the same number of plated reflectors; and its light, on clear and cloudless nights, was visible at a distance of eleven leagues. Seven hundred gallons of oil, we are told, were

* We think, however, that this statement is in great need of verification.

consumed annually; and in stormy nights the blaze attracted hundreds of small birds, which dashed themselves against the glass reflectors, and were killed.

Owing to its great elevation, however, this lighthouse was of little service in hazy and foggy weather. The

NEEDLES LIGHTHOUSE.

Trinity House, therefore, in 1859, caused a new one to be constructed on the outer part of the farthest of the celebrated chalk rocks, called the Needles, which was previously cut down and levelled almost to the water's edge.

This lighthouse is about 109 feet in height from the base to the top of the ball, and possesses only one light, with three concentrated wicks, whose brilliancy, however, is so great that it can be seen fourteen miles at sea. The shades are alternately white and red. A fog bell is rung by mechanical agency during stormy weather; its sounds may be heard at a distance of five miles. The base of the building is 38 feet in diameter.

Near the south shore of the Isle of Wight rises the remarkable and picturesque eminence of *St. Catherine's Hill*, 769 feet above the level of the sea. It looks down upon the rock-bound sweep of Chale Bay, which has been the scene of many deplorable catastrophes. From its summit the traveller commands a prospect of singular beauty, as remarkable for its extent as for its variety; since it not only includes by far the larger part of the "garden-isle," but the green masses of the New Forest, the blue line of the misty Hampshire hills, and the undulating range of the coast of Sussex as far as the bold bluff promontory of Beachy Head. It is said that, in an opposite direction, the high lands about Cherbourg have occasionally been seen. On a calm, clear day the island lies at your feet like an open map, and you can trace each bare bold hill; each valley, dusky with its wealth of foliage; each village church and manor-house, girt with venerable trees; each distant town, with its floating canopy of smoke; each stream that trails like a silver snake through the emerald pastures; and all around and about, the mighty ocean, heaving with a flood of glorious light.

On the lofty summit of this hill, one Walter de Godyton, in 1323, erected a chantry, and dedicated it to St. Catherine, who, in the Roman Hagiology, is the invariable patroness of hills and mountains. He also provided an endowment for a priest, who should chant masses, and keep up a burning light through the hours of darkness, for the safety of mariners approaching this dangerous coast. This duty was regularly performed until the suppression of the minor religious houses, when the priest and his endowment disappeared; though the chantry, built of solid masonry, remained, and is still to be inspected by the curious. Many years ago it was carefully repaired, in consideration of its value as a landmark. The foundation of the whole chapel was then cleared and levelled, a process revealing not only its ground-plan, but also the floor and stone hearth of the priest's little cell at the south-west corner. Its height is 35 feet 6 inches; its form, octagonal.

Almost adjoining stands the shell of a lighthouse erected in 1785 by the Trinity Board; but discontinued when it was discovered, as might at the outset have been surmised, that the mists so often gathering about the crown of the hill would render it of little service.

The dangerous character of the coast, however, was so widely known, that the Trinity Board felt it necessary to provide for its better protection, and in 1838 a lighthouse was commenced on *St. Catherine's Point*, at the base of the hill, which was completed in 1840, and lighted for the first time on the 25th of March. Its dimensions are:—From the water-mark to the level of terrace, 81 feet. From the terrace to the top of the stone-work, 100 feet. Height of lantern and pedestal, 1 foot 6 inches. Extension of glass frame, 10 feet. Roof, ball, vane, and lightning conductor, 11½ feet. Height of tower, 122 feet. The diameter of the interior is 14 feet; and the staircase to the lantern-room numbers one hundred and fifty-two steps. The illuminating apparatus consists of one lamp, 3½ inches diameter, with four concentrated wicks, reflected through a lens surmounted by two hundred and fifty mirrors.

St. Catherine's lighthouse is a graceful structure, and the visitor, comparing it with the rude chantry on the brow of the hill, where the solitary priest muttered his orisons and fed his flickering fire, will obtain a vivid conception of the vast strides made by practical science in five centuries.

A graphic writer * describes the extreme south-western point of England, the Land's End, in the following language:—

"Those," he says, "who expect to see a towering or far-stretching promontory will be disappointed. We form our ideas from ordinary maps, and imagine England's utmost cape to be a narrow tongue thrust out from the firm shore, along which we may walk to meet the advancing waves. But we find the reality to be merely a protruding shoulder or buttress of the vast irregular bluff that terminates the county. Cape Cornwall, which looks so grand about two miles distant, appears to extend further to the west than the Land's End.

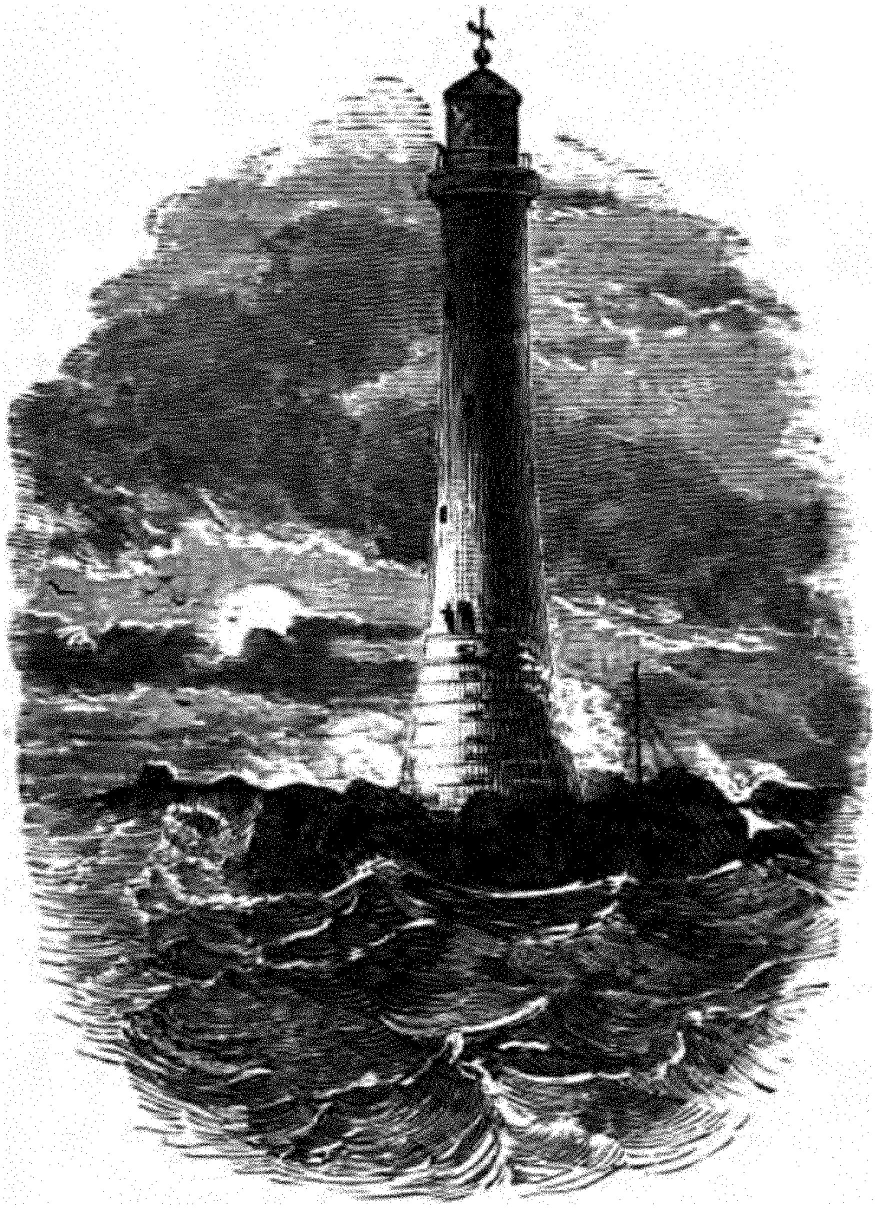
"Sit still and gaze: the scene grows upon you. Here the two channels commingle with the ocean; and far out

* Walter White, "A Londoner's Walk to the Land's End," pp. 192, 193.

as eye can reach, and round on either hand till it meets the remotest point of the rugged shore, stretches the watery expanse. The billows come tumbling in, and break in thunder at the base of the cliffs, dashing the impatient spray well-nigh to their summit. You may descend by steep paths to a lower level, and see the cavernous opening which their plunging assaults have worn through from one side of the buttress to the other. With what fury they rush into the recess, and make horrid whirlpools behind the mass which some day will be an isolated member of the rocky group scattered along the shore! There, on the largest of the cluster, nearly two miles from shore, stands the *Longships Lighthouse*, and all between is foam and swirl; waves running together, and leaping high with the shock: a dangerous channel known as the Kettle's Bottom. See how the water chafes around the Armed Knight there on the left, and the Irish Lady on the right, and all the nameless lumps! Yonder, under the cape, at the extremity of Whitesand Bay, are the Brisons, invested by shipwreck with a fearful interest."

The *Longships Lighthouse*, mentioned in the foregoing extract, was erected in 1795 by a Mr. Smith, who received as his reward the right to levy a toll upon shipping for a limited number of years. It was afterwards purchased of his representatives by the Trinity House. The tower is built of granite, and the stones are trenailed upon Smeaton's plan, as introduced in his great monument of the Eddystone. The circumference at the base is 62 feet, the height from the base to the vane of the lantern, and from the sea to the foot of the building, 51 feet. The total height, therefore, exceeds 100 feet. Yet the lantern-panes, it is said, have been frequently shattered by the waves.

About eight miles from this part of the Cornish coast lies a dangerous rock of greenstone, called the *Wolf's Crag*,



WOLF'S CRAG LIGHTHOUSE.

in the midst of a turbulent swirl and eddy of waters. An attempt was once made to plant on its summit the figure of an enormous wolf, constructed of copper, and hollow within, and so constructed that the mouth receiving the blasts of the gale should emit a loud hoarse sound to warn the seaman of his peril. The project, however, was rendered abortive by the violence of the elements.

In 1870 a lighthouse was successfully erected on the Wolf's Crag;—a circular tower, 100 feet high.

The uninhabited island of Annette, one of the Scilly group, is literally surrounded with reefs and rocks, each of which is associated with some melancholy tale of suffering and death. It has been well said that they are the "dogs" of Scilly, and fierce as those which, according to the old fable, howled round the monster of the Italian seas:—

> "But Scylla crouches in the gloom,
> Deep in a cavern's monstrous womb;
> Thence darts her ravening mouth, and drags
> The helpless vessel on the crags." *

On the Gilstone Sir Cloudesley Shovel, the gallant old sea-captain of Queen Anne's reign, was wrecked in 1707; on the Crebawethan perished the "Douro," and all hands, in 1843; and on Jacky's Rock, in 1841, the "Thames" steamer went to pieces, and out of sixty-five on board only three were saved. The westernmost of those terrible rocks is the *Bishop Rock*, and here a lighthouse was erected in 1858, from the design of Mr. James Walker. It is built of granite, and the vane is 147 feet above high water mark. The first stone, one of the fifth course, was laid on the 16th of July 1852; and on the 30th of the same month was laid the lowest stone, one foot below the level of low water spring-tides, in the chasm of the rock. The stone-work of the tower was finished on the 28th of August 1857; and the light, a fixed bright dioptric light

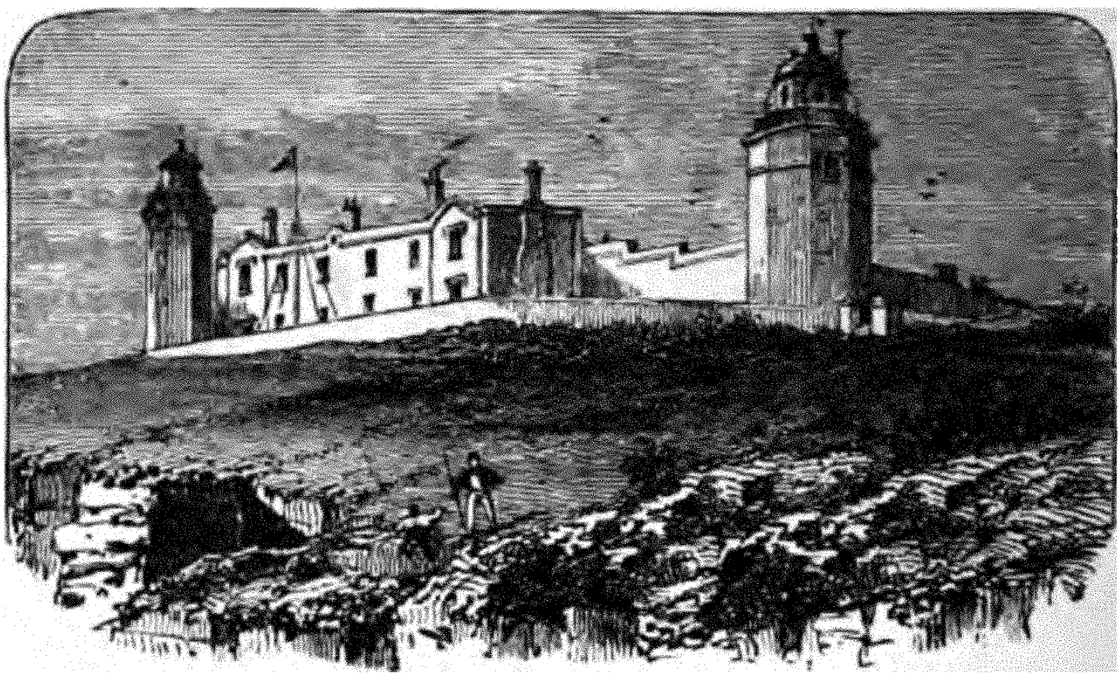
* Virgil, "Æneid," transl. by Conington, bk. iii. 420.

BISHOP ROCK LIGHTHOUSE.

of the first order illuminating the entire circle and visible, in clear weather, at a distance of fourteen miles, was exhibited on the 1st of September 1858.

It is satisfactory to add that this difficult enterprise was carried to a successful termination without loss of life or serious accident to any person employed.

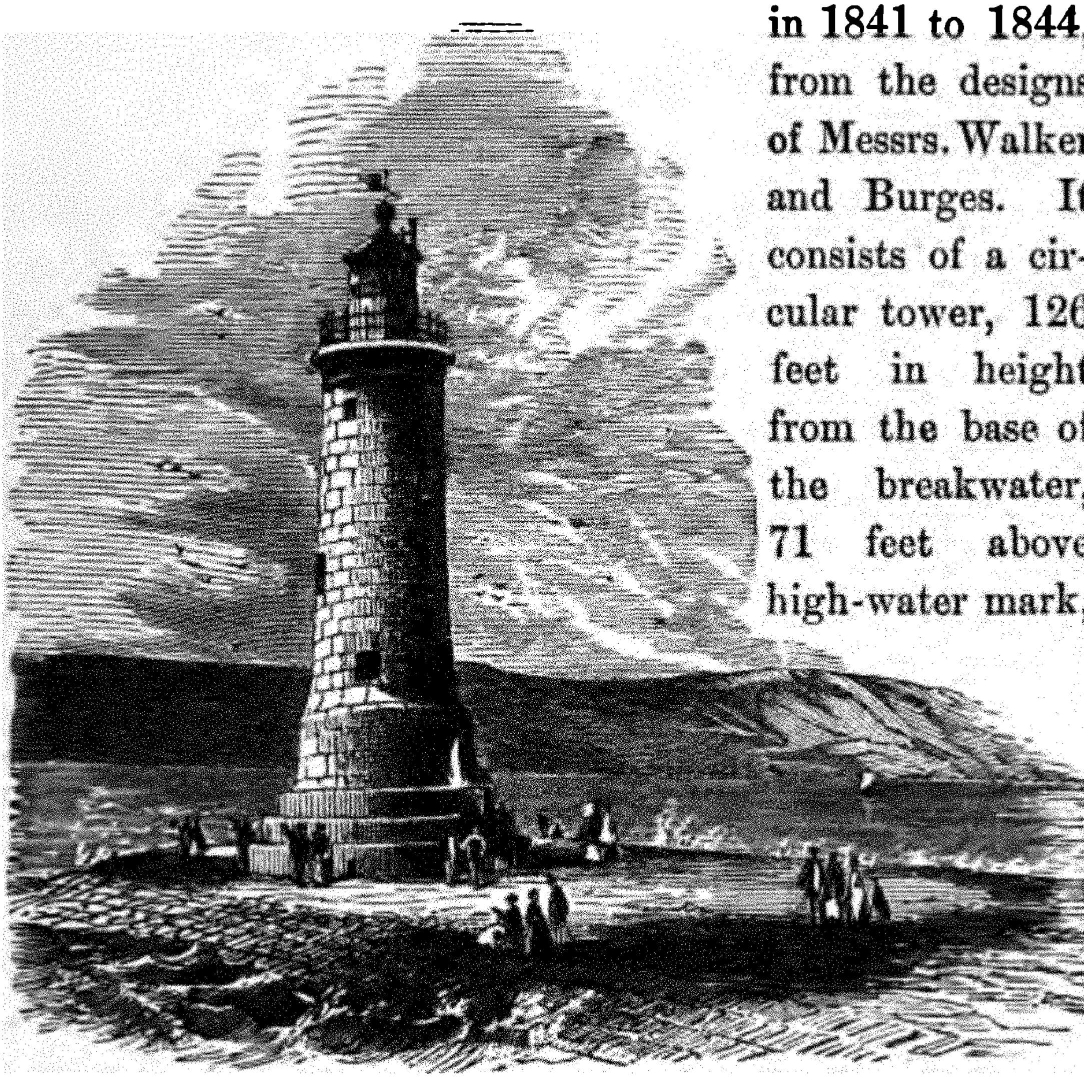
One of our most famous English headlands is *Lizard Point*, the *Ocrinum* of Ptolemy, the ancient geographer, and the most southerly promontory of England. Here are two large and massive lighthouses, whose bases are 168 feet above the sea, and 212 feet apart. Each tower is 61 feet high, and each lantern contains nineteen reflectors, which can be seen at a distance of twenty-one miles. Between the two, which were erected by Mr. Fonnereau, in 1751, and worked with coal-fires up to the year 1813, are built the residence and offices; so contrived that a long passage leads from one to the other, whereby



LIZARD POINT LIGHTHOUSE.

the keepers communicate without going out of doors. "These beacons," says a recent writer, "display two lights, to distinguish the Lizard from Scilly, known to mariners by one, and from Guernsey, which exhibits three. Notwithstanding, however, the brilliant illumination which is hence thrown for miles over the sea, ships, embayed in thick weather between the Lizard and Tol Pedn Penwith, are frequently lost in the vicinity of this headland, and the cliffs are of such a character that it is almost impossible to render from them the slightest assistance."

The *Plymouth Breakwater*, which protects the great Devonshire harbour from the furious gales of the Channel, carries on its western arm an important lighthouse, erected in 1841 to 1844, from the designs of Messrs. Walker and Burges. It consists of a circular tower, 126 feet in height from the base of the breakwater, 71 feet above high-water mark, and 18 feet in diameter at its widest part It is built of the finest Cornish granite and divided into five stories, the highest of which, the lantern, has a floor of polished slate; the others, of stone The light, a dioptric one, has a range of nine miles.



PLYMOUTH BREAKWATER LIGHTHOUSE.

On the dark craggy headland of *Start Point*, about 112 feet above high-water mark, is situated a lighthouse exhibiting *two* lights; a revolving light for the Channel, and a fixed light to guide ships inshore clear of the Skerries shoal. Mr. White thus describes the tower and its "belongings:"—

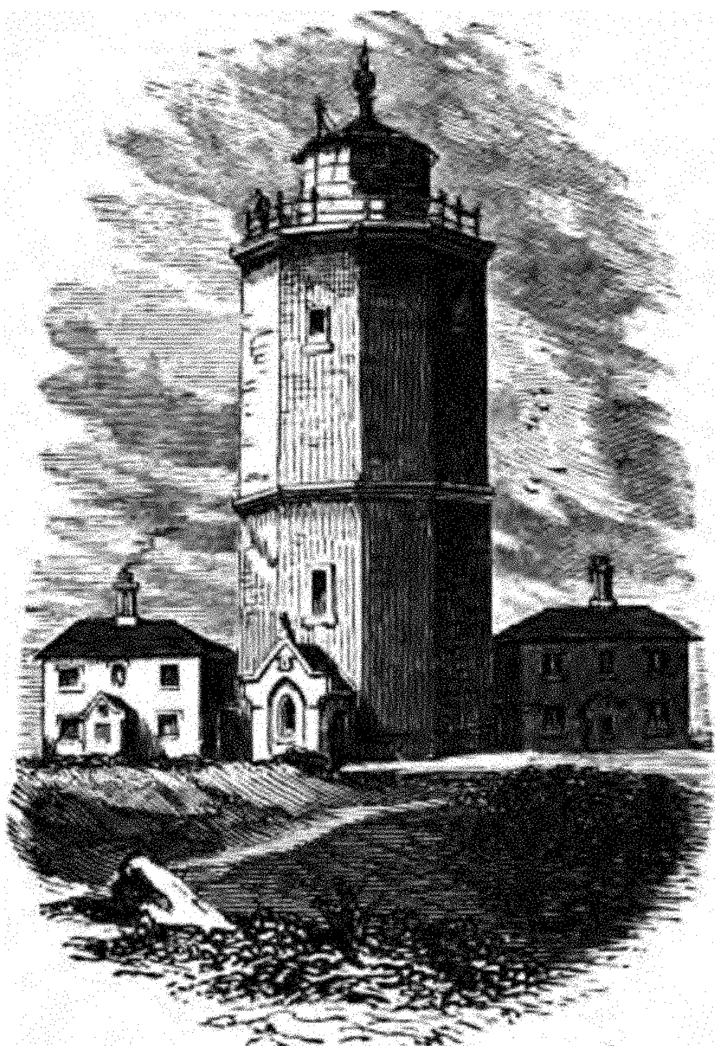
"A substantial house, connected with the tall circular tower, in a walled enclosure, all nicely whitened, is the residence of the light-keepers. The buildings stand within a few yards of the verge of the cliff, the wall serving as parapet, from which you look down on the craggy slope outside and the jutting rocks beyond—the outermost point. You may descend by the narrow path, protected also by a low white wall, and stride and scramble from rock to rock, with but little risk of slipping, so rough are the surfaces with minute shells.

"A rude steep stair, chopped in the rock, leads down still lower to a little cove and a narrow strip of beach at the foot of the cliffs. It is the landing-place for the lighthouse-keepers when they go fishing; but can only be used in calm weather.

"The assistant-keeper spoke of the arrival of a visitor as a pleasure in the monotonous life of the establishment. Winter, he said, was a dreary time, not so much on account of cold, as of storms, fogs, and wild weather generally. In easterly gales the fury of the wind would be often such that to walk across the yard was impossible; they had to crawl under shelter of the wall, and the spray flew from one side of the Point to the other. But indoors there was no lack of comfort, for the house was solidly built and conveniently fitted, and the Trinity Board kept a small collection of books circulating from lighthouse to lighthouse."

There are two lighthouses at *Portland Bill;* the lantern of one 136, and that of the other 210 feet above the sea. Between the chalk cliffs and a bank called the *Shambles*, foams the wild impetuous current of the Race of Portland.

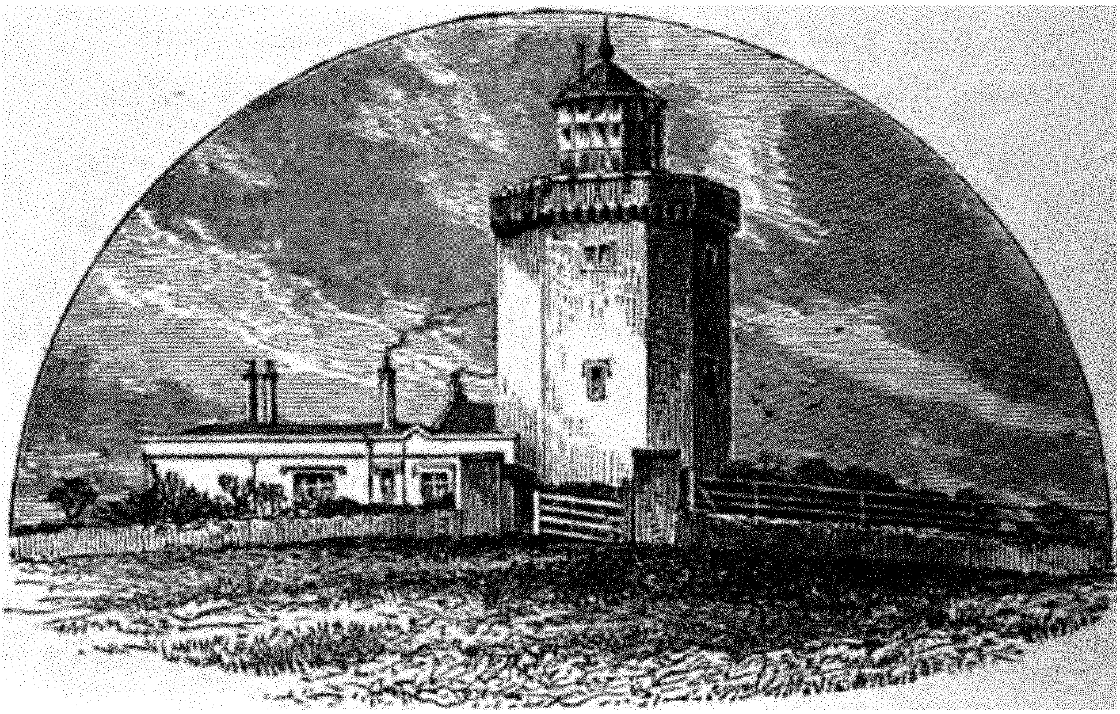
The celebrated chalky range of the South Downs terminates on the Sussex coast in *Beachy Head*, an abrupt precipitous promontory, 575 feet above the sea level On a point considerably lower than this lofty headland and projecting much further into the sea stands the celebrated Belle Tout Lighthouse, erected in 1831.



NORTH FORELAND LIGHTHOUSE.

The *North Foreland*, one of the great Kentish promontories, is also crowned by its lighthouse, which dates from 1790. The light is visible at the Nore, a distance of twenty miles.

At the *South Foreland* lighthouse, a few mi'es from Dover, the electric light is used; the electric current being originated by a set of enormous horse-shoe magnets fixed



SOUTH FORELAND LIGHTHOUSE.

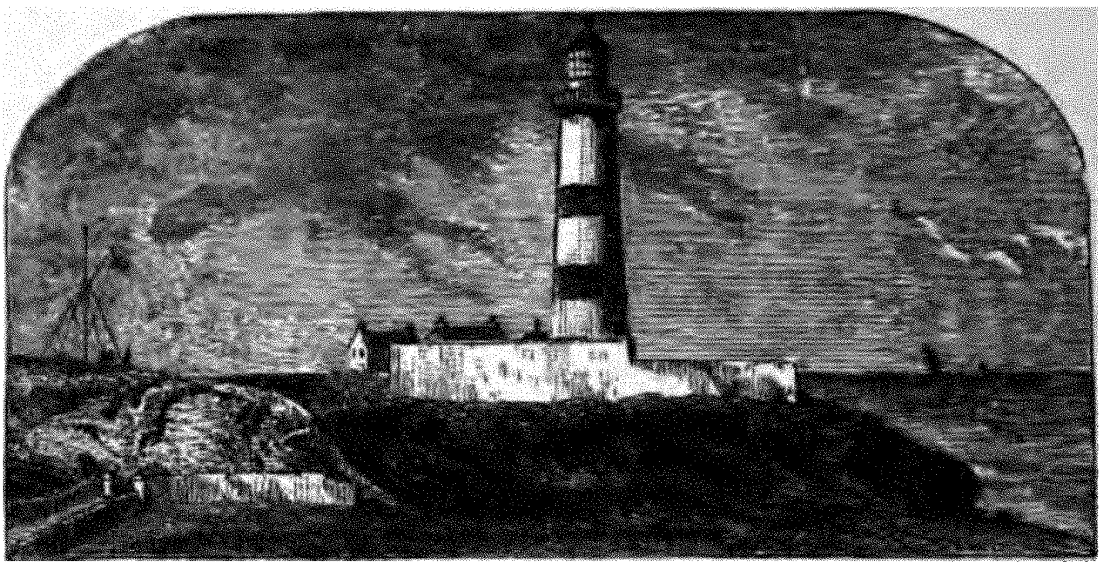
in a stand, before which a wheel revolves, loaded with a number of solid iron cylinders. The whole apparatus is set in motion by a steam-engine.

Both the east and west coasts of our "sea-girt island" are well provided with warning lights, but a mere enumeration of them would scarcely be satisfactory to the reader, and a description would prove as wearisome as a twice-told tale, for the reason stated at the beginning of this chapter. If we traced the coast-line of Scotland, we should find it equally well defended; or if we crossed to the Isle of Man, we should still meet with the monuments of man's warfare against the ocean. Then, again, if we cross from Holyhead to Dublin, our vessel is guided by the stately light which glows upon the Stack Rock, and by the Bailey Light-

HOLYHEAD LIGHTHOUSE.

house at the extremity of the Howth peninsula. The Bailey on the north, and the Kish Lightship on the south, mark the extreme points of the beautiful Bay of Dublin. Keeping southward, along the eastern coast, we descry the lighthouses on the rugged cliffs of Wicklow Head, and in Tuskar Rock; and, on the south coast, at Hook Tower, marking the eastern side of the entrance to the port of Waterford;

at Ballinacourty, as a guide to ships entering Dungarvan Harbour; at Mine Head, and Ballycottin Point, and Roche Point, the north-eastern boundary of Cork Harbour; and at the Old Head of Kinsale, whose light is visible for twenty-



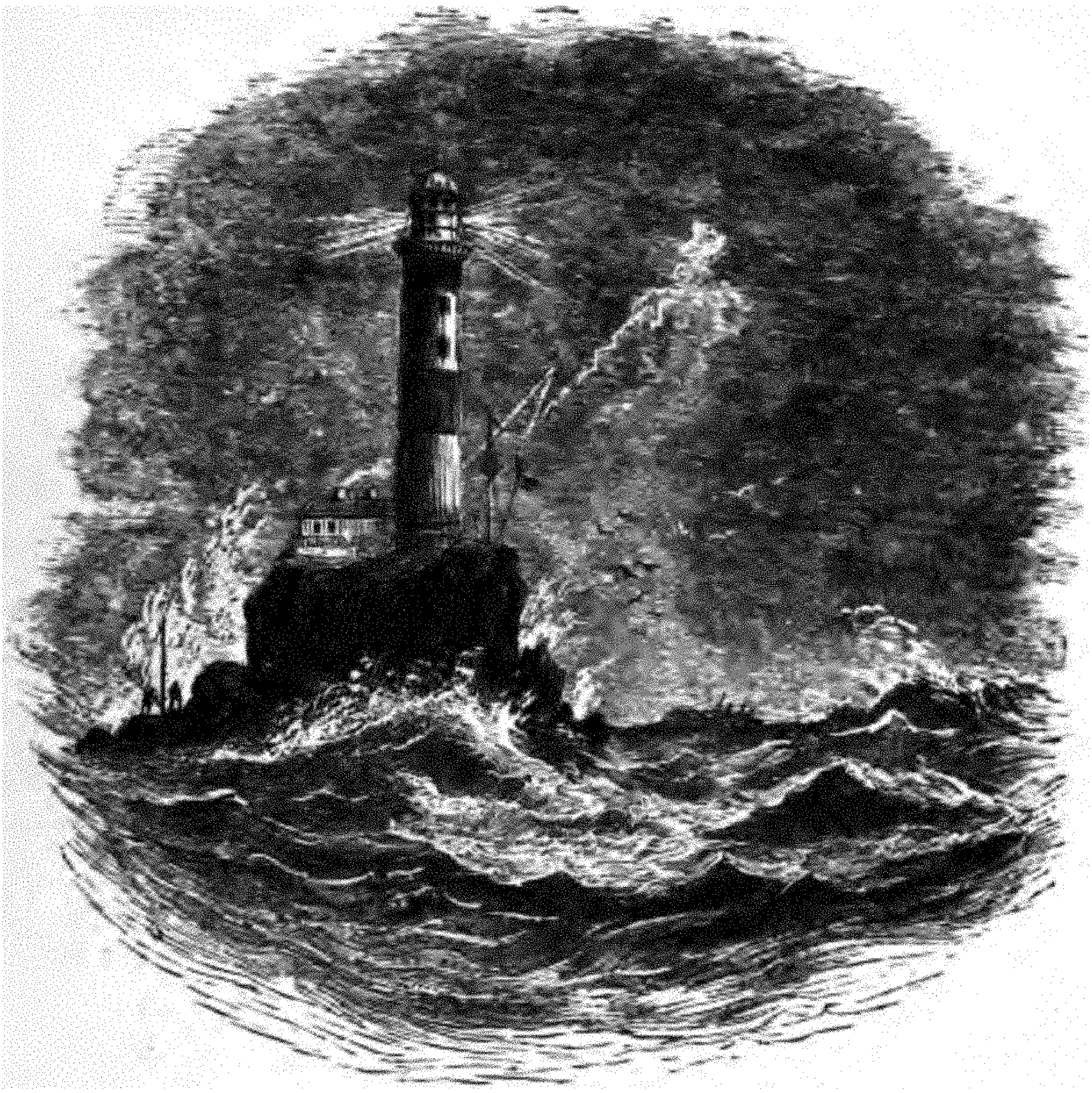
KINSALE LIGHTHOUSE.

one nautical miles, and proves immeasurably welcome to the Briton home-bound from the New World, because it is the first he sees after his departure from American waters.

A revolving light, which gradually increases and decreases every two minutes, is exhibited on the *Fastnet Rock*, a few miles off the southernmost point of Ireland.

Of iron lighthouses the British coast presents but few examples. The reader will, therefore, be not unwilling to gain some particulars of the tower on this well-known rock; a rock rising about 60 feet above high-water mark. Its iron structure consists, in the main, of the following parts:*—The shell, composed of cast-iron plates; the hollow cast-iron central column; five cast-iron floors, the uppermost of which is the platform at the top of the

* Practical Mechanic's Journal for 1842, p. 265.



FASTNET ROCK LIGHTHOUSE.

tower supporting the lantern; a projecting cast-iron gallery, level with the platform, sustained by cast-iron brackets, and having a balustrade, an external iron stair, for access to the doors on the first floor, internal iron stairs to connect the several floors, a lining of masonry in the basement, and of brick in the upper stories, and a cut stone moulding round the base.

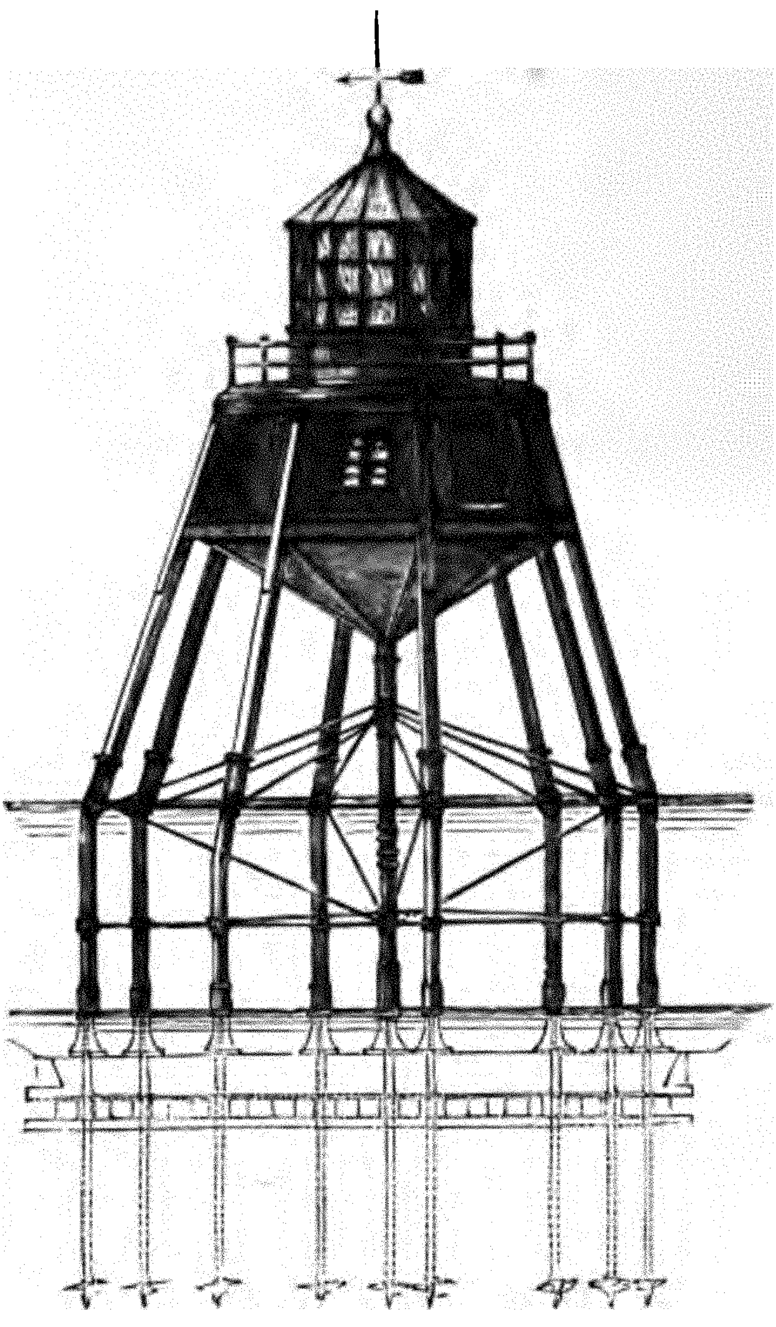
The principal dimensions are as follows.—

	Feet.	In.
Height of tower from the base to the gallery	63	9
Height of lamp above the gallery	11	0
Total height of the lantern	30	0
Outside diameter at base, over stone moulding	23	0

	Feet.	In.
Outside diameter over cast-iron shell..................	19	0
Outside diameter just below the cornice	13	11¼
Outside diameter of tower casing at light-room floor....	13	8¼
Outside diameter of gallery, to outer ends of brackets ..	19	10¼
Inside diameter of cellar, or basement story............	9	0
Inside diameter of each of the other four stories........	12	0
Clear height of cellar..................................	9	0
Clear height of each of the other four stories...........	12	0
Total thickness of each floor..........................	0	9

The plates composing the cast-iron shell are curved, oblong, rectangular, and 1⅜ inch thick at the base, diminishing gradually to ⅞ inch at the top of the tower.

This lighthouse was erected in 1848, from the design of Mr. Halpin, engineer to the Corporation of Dublin.



MAPLIN SANDS LIGHTHOUSE.

Of lighthouses on piles we shall take as an example the *Maplin Sands Lighthouse*, designed by Mr. Walker, for the Trinity House Corporation, and erected in 1841.

It stands upon nine piles of wrought-iron, each 26 feet long and 5 inches in diameter: these are screwed 14 feet 6 inches deep into the sand, and secured by screw-blades of cast-iron, each 4 feet in diameter. One pile forms the centre of an octagon; the others are placed one at each of the eight angles. To the tops of the piles are firmly fitted hollow iron columns; the central one being perpendicular, the others bent, so that they incline inwards. They are braced together by radiating, diagonal, and horizontal rods. Each terminates at the top in a socket, into which is fitted a timber post of about one foot square. The posts, like the columns, are braced together, and form the foundation of the house, platform, and lantern.

The principal dimensions are as follows:—

	Feet.	In.
Depth of the screw-blades below the sand, about	14	6
Depth of the screw-blades below low-water mark spring-tides	21	0
Rise of spring-tides	15	0
Height from high-water mark spring-tides to floor of house	20	6
Height from high-water mark to floor of light-room	29	6
Height from high-water mark to lamp	38	6
Height from high-water mark to top of vane spindle	54	0
Diameter of floor of house	27	0
Diameter of platform	21	0
Diameter of light-room	12	0

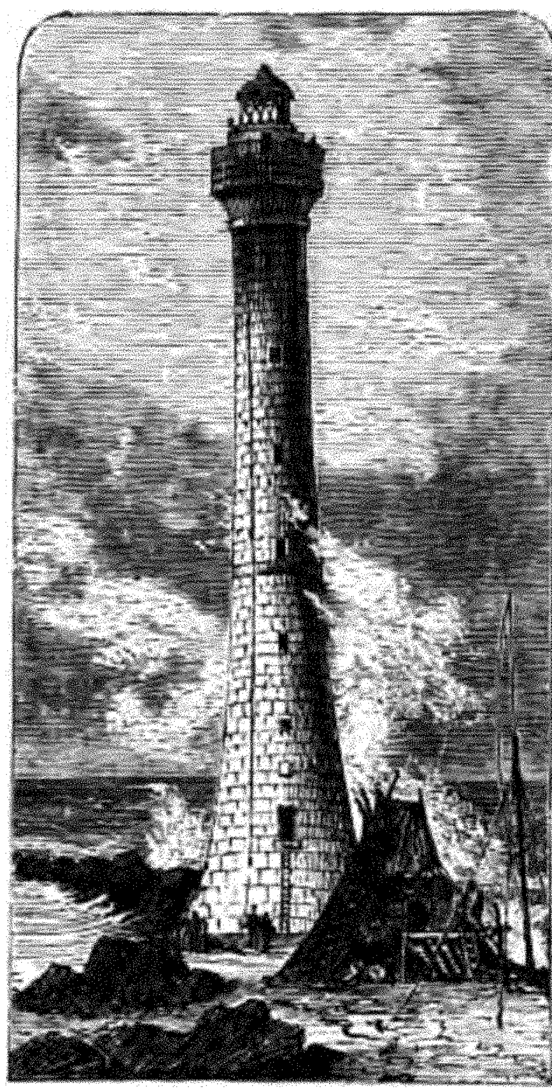
A lighthouse of this kind is excellently adapted for any locality where the light does not require to be seen at a great distance. The piles offer no appreciable opposition to the waves, which pass through the open spaces without rising higher than out at sea.

The *Gunfleet Lighthouse* stands on seven screw piles, screwed 40 feet deep into the sand. The *Point of Ayre Lighthouse*, on nine, screwed 12 feet into the sand.

Before we conclude these desultory notes, it seems desirable to refer to a lighthouse now in course of erection, which is not unworthy to rank with the finest of its predecessors.

About midway between the famous Skerryvore Lighthouse and that of the Rhins of Islay—or 20 miles from Islay, 18 miles from Colonsay, 15 miles from Iona, and 15 miles from Mull—in the centre of an archipelago which ancient legend, and ecclesiastical history, and modern romance have done their best to render celebrated—lies the *Dubhe Artach* (or *St. John's*) *Rock*. It forms an isolated mass of augite about 240 feet in length by 43 feet in breadth, whose rounded summit rises 47 feet above high-water mark. In stormy weather the sea sweeps over it with terrific violence, and for miles around it boils and seethes with counter-currents and opposing waves. During the severe gales of the winter of 1865–66 many ships were lost in this dangerous neighbourhood, and it was therefore determined by the Commissioners of Northern Lighthouses, with the sanction of the Trinity House and Board of Trade, to erect a lighthouse on the Dubhe Artach.

The material of the rock is so excessively hard that the works, at first, could not be carried forward with much rapidity. Neither in the building of the Eddystone nor of the Skerryvore could the engineers have had greater difficulties to contend with. A foundation has, however, been at last obtained, and several courses of the masonry securely laid, so that the elegant structure, designed by Messrs. D. and T. Stevenson of Edinburgh, will, in another twelvemonth, be completed. Its estimated cost is £56,900. It consists of a parabolic frustrum, whose topmost course is 109 feet above its base. The diameter at the bottom measures 36 feet, at the top 16 feet. There will be seven apartments besides the light-room. The total height of the lantern above the sea will be 154 feet, commanding a range of about eighteen miles.



ALGUADA REEF LIGHTHOUSE.

Lastly, we propose to wander away from the shores of the United Kingdom, though not to trespass beyond the confines of British territory. Had our limits permitted, we might have entered upon a description of the Australian and North American pharoses, of the lighthouse at Perim, of the lighthouses on the coast of Hindustan; but such a multiplicity of details would assuredly have wearied the reader. Yet, as a proof that our engineering operations in this department are not less skilfully and boldly executed abroad than at h , we shall adduce, in terminating this chapter, the noble structure situated on the Alguada Reef.

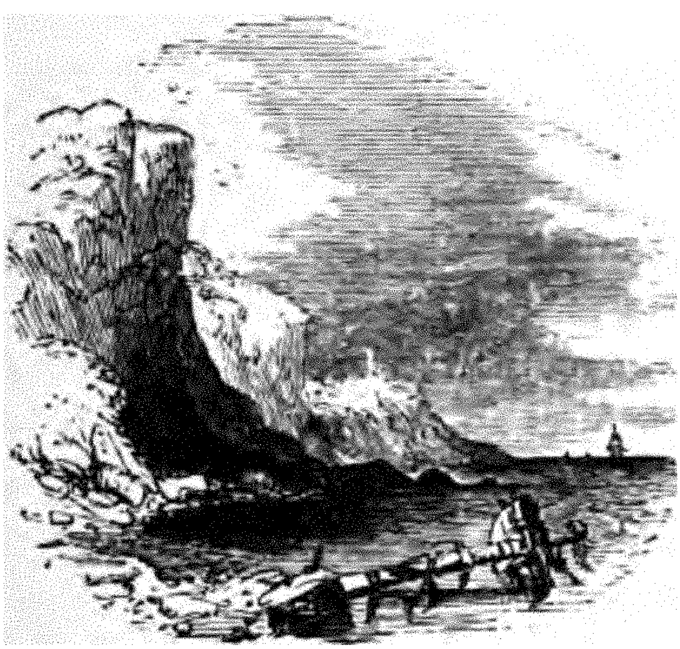
This reef lies a few miles to the southward of Cape Negrais, the south-west promontory of Pegu, near one of the mouths of the great Irrawady river. Being thrown, as it were, directly in the track of vessels sailing from Calcutta to the thriving ports of Moulmein and Rangoon, it was a constant danger to the mariner; for the sea, except in the calmest weather, always dashes against it with restless fury, and no vessel cast upon it can hope to escape. The late Marquis of Dalhousie, appreciating its perilous character, designed to erect a lighthouse upon it; but no action was taken in the matter until 1856, when the loss of a coolie ship and 286 lives induced Lord Canning to resume his predecessor's project.

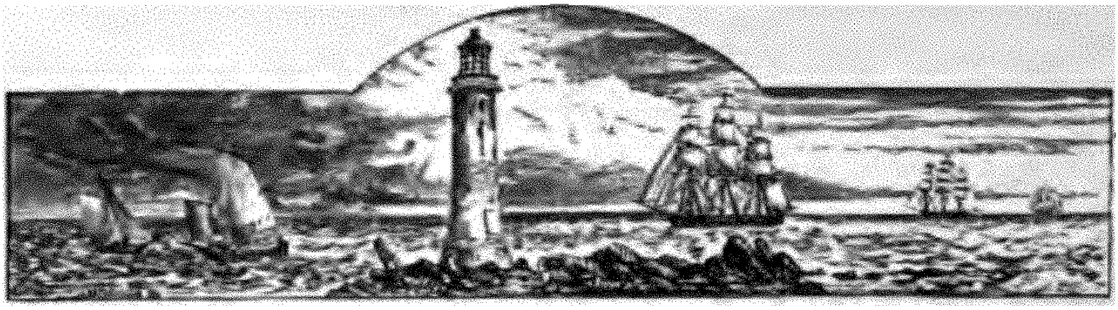
The stone had to be brought from Pulo Obin, near Singapore, a distance of 1200 miles; and it was not until January 1860 that the work of excavating the foundation was commenced. On February 14, 1861, the first stone was laid, and thenceforth the work proceeded bravely, though entirely carried on by Coolie labour. The light, a first-class holophotal light, designed by Messrs. D. and T. Stevenson of Edinburgh, was first kindled on April 23, 1865, at an elevation of 144 feet above high-water mark. It commands a range of twenty nautical miles.

In general appearance the Alguada Reef Lighthouse resembles the Skerryvore, after which, indeed, it was designed, by Captain Fraser; but it surpasses its model in its dimensions.

[Here we conclude our sketches of celebrated lighthouses;

structures, we think, scarcely less deserving of the public interest and admiration, than the triumphal arches and stately columns erected to the memory of successful generals, or the superb palaces which enshrine the magnificence of kings and princes. For every lighthouse, be it remembered, is a proof of formidable engineering difficulties successfully overcome, and, therefore, rises before us as an impressive monument of human ingenuity, skill, and perseverance, exerted, for the noblest of purposes—for the preservation of human life, for the prevention of that misery and grief and deep-abiding sorrow which are the invariable consequences of the "wreck ashore."





BOOK IV.

LIGHTHOUSES IN FRANCE.

CHAPTER I.

THE TOUR DE CORDOUAN.*

"TRULY mysterious is the Channel, in that narrow gullet where it engulfs the waves of the North Sea. Violent are the waters of Brittany, as they eddy to and fro in the ravines of its basaltic coast. But the Gulf of Gascony, from Cordouan to Biarritz, is a sea of contradictions; an enigma of strife and struggle. As it stretches southward, it suddenly acquires an extraordinary depth, and becomes an abyss in which the waters are swallowed up. An ingenious naturalist has compared it to a gigantic funnel, which abruptly absorbs all that is poured into it. The flood, escaping from it under an awful pressure, remounts to a height of which our seas afford no other example." †

* Our account of the French lighthouses is mainly taken from M. Rénard's

The eloquent historian of the sea does not paint in colours too vivid the raging excesses of the Gulf of Gascony; and, therefore, from a remote epoch, the French government have sought to guard against its dangers by securing a proper lightage of the entrance of the Gironde. To trace the origin of the Lighthouse of Cordouan we must go back to a very distant antiquity. Unfortunately we know little of the history of this marvellous erection on a craggy platform, which is alternately covered and exposed by the waves at every tide. It is certain that the present structure had, at least, two predecessors. If tradition may be credited, the first was raised by Louis the Debonnair. But as no document is extant to support this hypothesis, we are inclined to believe that no lighthouse was built there until the thirteenth century, and that it was then erected in compliance with the urgent request of the merchants of Cordouan, and foreign merchants trading in the wines of Bordeaux. Matthew Paris records, in his well-known "Chronicles," that the Moors having been driven back to the extreme south of Spain, extensive commercial relations were established at this epoch (1236) between the Gascons and the cities of Cordouan and Seville. Hence came the name of Cordouan. That this etymology is contradicted by many scholars, and even turned into jest, we are aware, but to ridicule is not to prove. What appears certain is, that the town of Cordouan (said to contain 300,000 souls in the thirteenth century, and the ancient capital of the Khalifate of the same name) had two reasons instead of one for demanding the establishment of a lighthouse at the mouth of the Gironde; for its merchants visited Bourdeaux not only to deal in its wines, but to sell their hides and leather, renowned then as now for their fineness and excellent quality.

But passing from the domains of conjecture to those of history, we know that the second lighthouse was built in the fourteenth century (1362-70), by the order of Edward the Black Prince. This lighthouse was 48 feet in height. It terminated in a platform, where was kindled a fire of wood under the charge of a holy hermit, who received in reward of his labours a toll from each vessel of two groats sterling. It is generally believed that the rock on which the lighthouse stood was, at that epoch, still united to the Medoc coast. The configuration of the soil, the distance, the depth of the channel, the ravages still effected by the sea at Soulac and at the Point de Grave, are arguments in favour of this opinion.

The lighthouse built by the Black Prince did not stand alone upon its rock. As a companion it had a chapel, raised in honour of the Virgin Mary, and several houses, constructed in this sacred locality, gradually formed a kind of village. Here dwelt the hermit, his assistants, and, probably, a small number of pilots and fishermen.

An engraving of the date of the fifteenth century represents this ancient tower as an octagonal building, with elongated quadrangular openings. It is doubled, so to speak, up to its first story, with an exterior casing of stone, forming an additional protection. Some of the houses which formerly occupied this particular site were existing at the epoch when the drawing was executed.

The lighthouse, which at the present time so justly extorts the admiration of all its visitors, was constructed,

ANCIENT TOWER OF CORDOUAN.

not on the ruins, but by the side of its predecessor. Begun in 1584 by Louis de Foix, a Parisian architect, to whom Philip II. confided at a later date the building of the Escorial, it was not completed until 1600, and then by his son. Including the solid mass of the platform or base, the tower was 60 feet high, and including the stone lantern, 70 feet. At the date of its erection, the ground was, as undoubtedly it for a long time had been, completely separated from the mainland, and formed an island of a certain extent—the "Isle of Cordouan," says Louis de Foix himself, in the contract signed with the authorities of

Guienne for the construction of the tower. This island has since disappeared, as well as the houses and chapel of which we have spoken; and now, at the foot of the monument, are only the bare rock and some tongues of sand completely covered at high water.

The pharos, as it issued from the hands of the Des Foix, father and son, consisted of a circular platform protected by a broad parapet, and of the tower, which was divided into four stories, not including the lantern. The ground floor presented a great vestibule of a quadrangular form, with four little recesses which served for magazines. Staircases placed in the embrasures of the entrance-gate and of the two windows led to the cellars and the water-tank. On either side of the doorway, prior to the Revolution, were busts of Henry III. and Henry IV. On the first story, which bore the title—probably without any justification—of "the King's Chamber," was a saloon of the same dimensions as the vestibule, but more richly decorated, from which access was obtained to the first exterior gallery. A chapel, circular in shape, occupied the second story, and was illuminated by two rows of windows, covered by a spherical vault, and enriched with Corinthian pilasters and elegant sculptures. Above the door of the chapel stood the bust of Louis de Foix; and the following sonnet, composed in the purest *galimatias* of the time, was engraved on a large tablet above it:—

QVAND IADMIRE RAVI CEST ŒVVRE EN MON COVRAGE
MON DE FOIX MON ESPRIT EST EN ESTONNEMENT.
PORTE DANS LES PENSERS DE MON ENTENDEMENT
LE GENTIL INGENIEVX DE CE SVPERBE OVVRAGE.

LA IL DISCOVRT EN LVY ET DVN MVET LANGAGE
TE VA LOVANT SVBTIL EN CE POINT MESMEMENT

QUE TV BRIDES LES FLOTS DV GRONDEVX ELEMENT
ET DVN MVTIN NEPTVNE LA TEMPESTE ET LORAGE.

O TROIS ET QVATRE FOIS BIENHEVREVX TON ESPRIT
DE CE QVAV FRONT DRESSE CE PHARE IL ENTREPRIT
POVR SE PERPETVER DANS LHEVREVSE MEMOIRE.

TV TES AQVIS PAR LA VN HONNEVR INFINI
QVI NE FINIRA POINT QVE CE PHARE DE GLOIRE
LE MONDE FINISSANT NE SE RENDE FINY.

All the parts of the primitive construction still exist, and have undergone but little alteration during successive restorations; but such is not the case with the upper portion, which has been completely destroyed, from the gradual sinking of the tower.

Above the second gallery, the dome of the chapel was ornamented on the outside by richly sculptured dormer-windows, forming the second tier of windows of that story. It was surmounted by a circular pavilion, vaulted, and decorated with composite pilasters, whose entablature was crowned by the open balustrade of an outer gallery leading into the lantern. This lantern—whose dimensions were somewhat limited—was built of hewn stone, and composed of eight arcades, whose piers were embellished with columns, and whose cupola terminated in a shaft to carry off the smoke of the furnace.

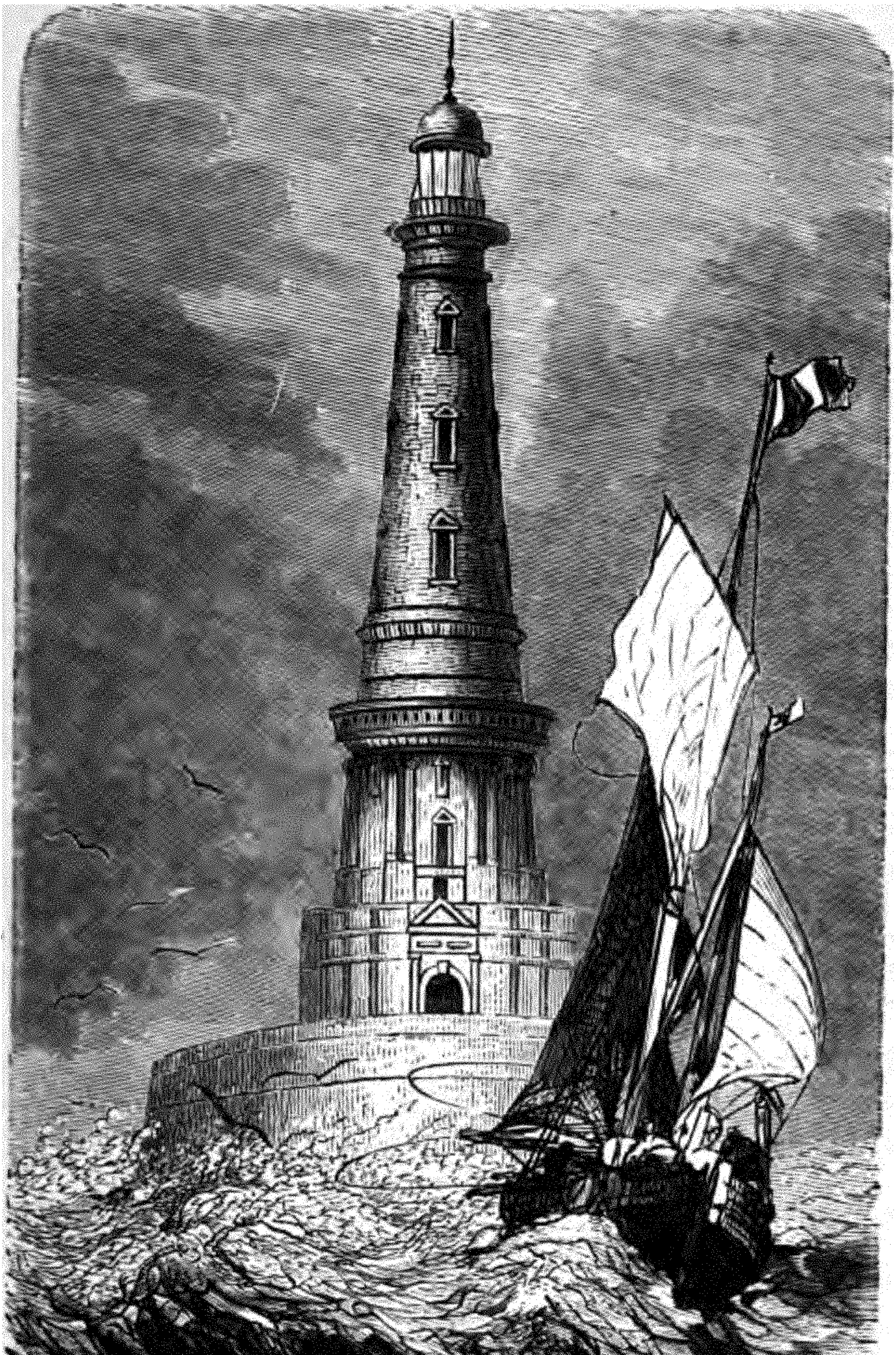
Under Louis XV., in 1727, an iron structure was substituted for this stone lantern, whose masonry had been calcined by the fire, and whose broad piers, moreover, had the serious inconvenience of obscuring a very considerable portion of the light; but the furnace was kept at the same elevation; namely, about 120 feet above the level of the highest seas.

This elevation, as it did not enable the light to be seen at a sufficient distance, was soon pronounced unsatisfactory. A scheme to raise it 100 feet was planned by the Chevalier de Borda, who submitted it to Teulère, the chief engineer to the city of Bordeaux. The latter pointed out that it was both imperative and possible to increase the height by 65 feet. His designs were accepted, and their successful execution, in 1788 and 1789, in spite of many dangers, procured for Teulère a reputation scarcely inferior to that of De Foix himself.

The light is now placed at an elevation above high-water level of 190 feet, and above the ground of 205 feet. But, regarded from an artistic point of view, we must confess that the lighthouse has by no means gained. There is a certain dryness about the too naked forms of the modern construction, which contrasts in a manner much to be deplored with the elegance and richness of the Renaissance work. The present summit (*couronnement*) is by no means equal to that which formerly existed. Yet, as Reynaud justly observes, the first impression which the edifice produces leaves no room for regret; you are penetrated with a profound feeling of admiration the moment you find yourself in the presence of this majestic monument, towering with so sublime a boldness above the bosom of the ocean.

These emotions have been finely expressed by Michelet in his noble book on "the Sea."

"During our six months' sojourn on this shore," he says, "our ordinary object of contemplation—I had almost said, our daily society—was Cordouan. We felt keenly how its position as guardian of the seas, as the constant watcher of the strait, made of it an individuality. Erect

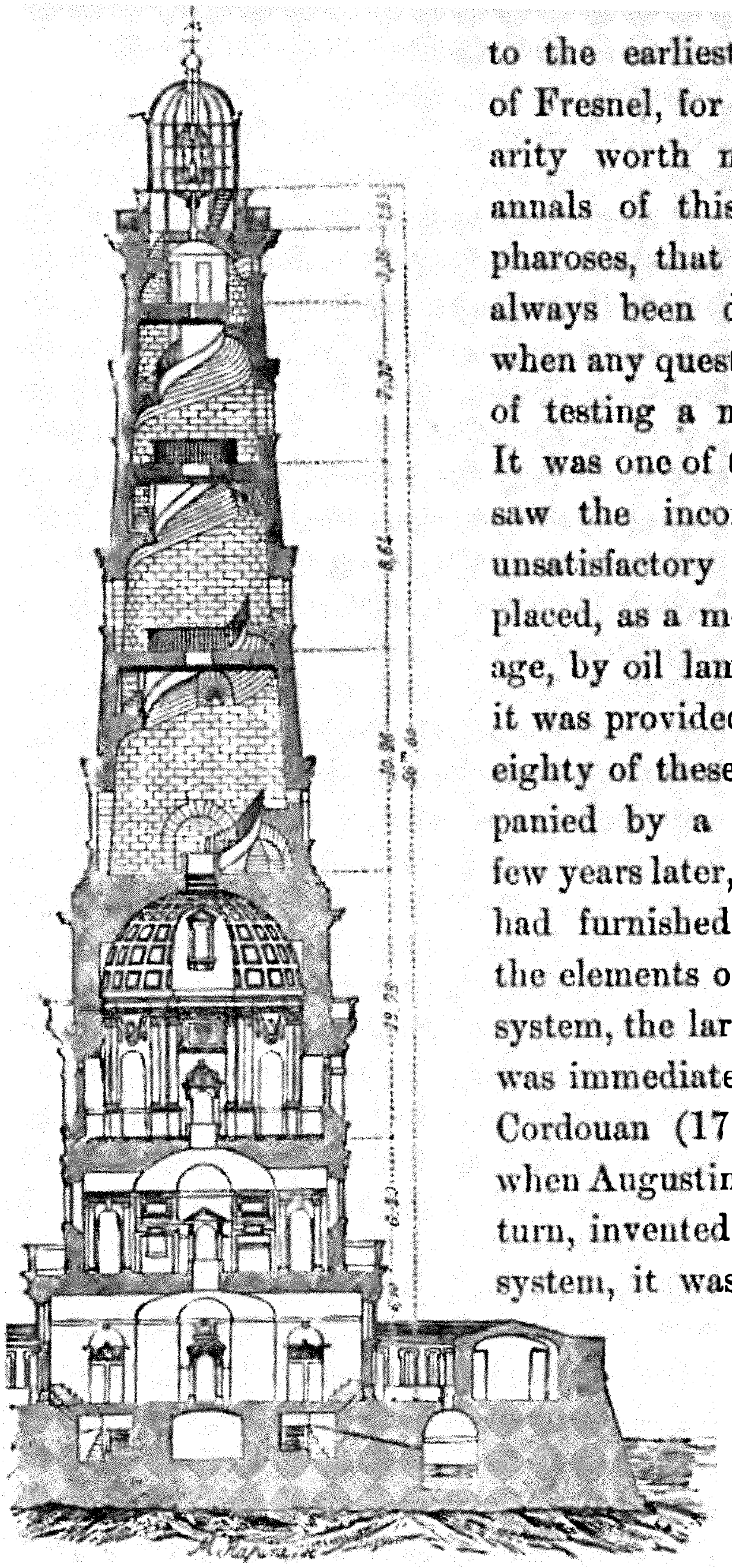


PRESENT LIGHTHOUSE OF CORDOUAN.

against the broad eastern horizon, it appeared under a hundred varied aspects. Sometimes, in a belt of glory, it triumphed under the sun; sometimes, pale and indistinct, it hovered through the mist, no augury of good. At evening, when it abruptly kindled its red light, and darted forth its glance of fire, it seemed like a zealous inspector, who watched over the waters, impressed and disquieted by his responsibility. Whatever occurred at sea was attributed to it. By illuminating the tempest, it was frequently a source of safety, and yet men ascribed to it the storm. It is thus that Ignorance too often treats Genius, accusing it of the evils which it reveals. Even we ourselves were not just. If it delayed lighting up, if bad weather came, we censured it, we growled at it. 'Ah, Cordouan, Cordouan, thou white phantom! canst thou, then, bring us nought but storms?'"

During the last few years a complete restoration of the lighthouse of Cordouan has been carried out, with the view of replacing the stones—and they were numerous—injured by the weather, and of renewing the sculptures, which it was difficult to trace, they were so worn and abraded. All the buildings which at different times had been erected against the platform-wall to supply the insufficiency of dwelling-apartments in the lighthouse, have been reconstructed. And in 1854 arrangements were made to distinguish it from neighbouring lights; it has now a revolving light, white and red, with a range of twenty-seven miles.

The introduction of the dioptric apparatus into the Cordouan lighthouse took place long ago; it belongs, in fact,

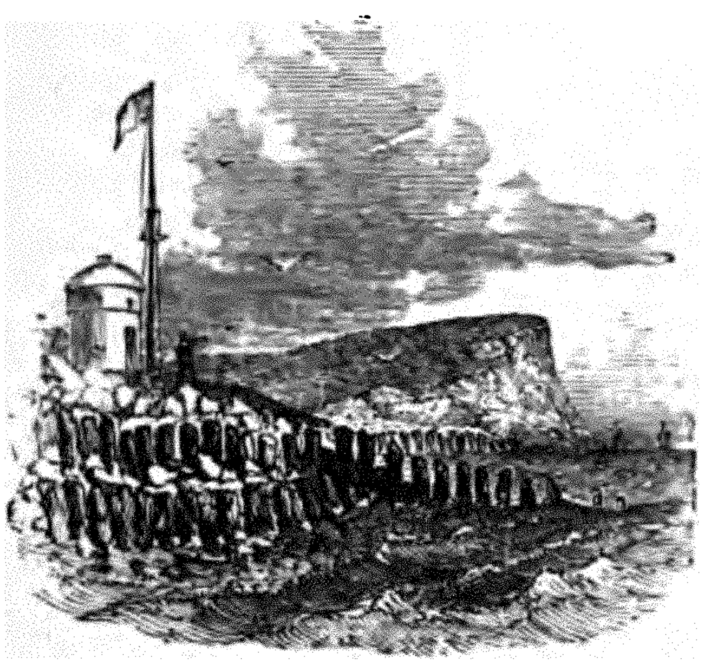


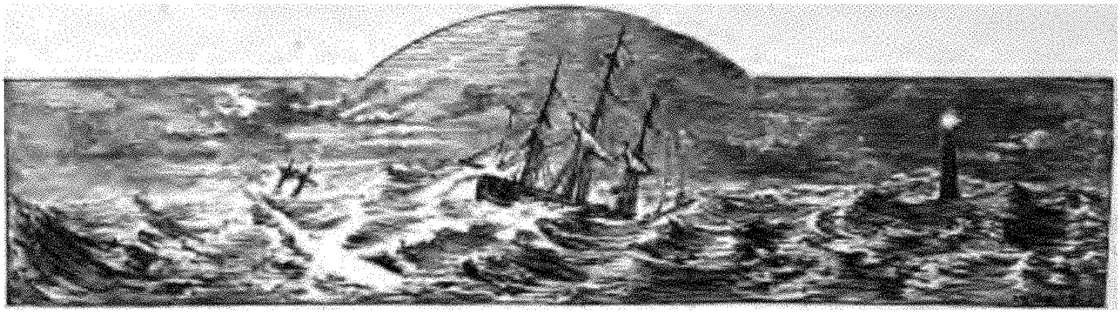
INTERIOR OF THE CORDOUAN.

to the earliest experiments of Fresnel, for it is a peculiarity worth notice in the annals of this patriarch of pharoses, that attention has always been directed to it when any question has arisen of testing a new invention. It was one of the first which saw the inconvenient and unsatisfactory *chauffer* replaced, as a means of lightage, by oil lamps. In 1782 it was provided with at least eighty of these, each accompanied by a reflector. A few years later, when Teulère had furnished Borda with the elements of the catoptric system, the largest apparatus was immediately installed at Cordouan (1790). Finally, when Augustin Fresnel, in his turn, invented the lenticular system, it was at Cordouan that experiments were first made with the most important model.

Considering, then, the numerous and valuable services which Cordouan has rendered, we ask ourselves, says M. Rénard,* whether, among the numerous monuments raised by the pride and daring of man, there are many of so much respectability as this "Patriarch of the Lighthouses!" We cannot acknowledge that any one of them is so justly deserving of our reverent admiration. Nobler, far nobler, and of infinitely greater utility, than the trophies by which the conqueror has tracked his bloody path, or the pompous boundary-stones erected by nations at each stage of their history, it will also be of a more permanent character. For these belong only to individuals or peoples: Cordouan belongs to the whole human race.

* Rénard, "Les Phares," pp. 145–153.





CHAPTER II.

THE LIGHTHOUSES OF CAPE LA HEVE.

A.D. 1774.

Doux feux qui protégez et Thétis et la Seine,
Sûrs et brillants rivaux des deux frères d'Hélène,
Phares, je vous salue ; assurez à jamais
Le commerce opulent de l'heureuse Neustrie ;
Fixez dans ma patrie
L'abondance, les arts, tous les fruits de la paix.

CASIMIR DELAVIGNE.

Ye fires which guard both Thetis and the Seine,
Bright shining compeers of the brothers twain—
Castor and Pollux—vigilant fires, all hail !
O gentle lights, I pray ye, never fail
To guide secure each wealthy Neustrian keel,
And to my country all the fruits reveal
Of blessèd peace, and guard the common weal !

NO one can have visited Havre without devoting at least an hour to the Cape La Hève, and to the two lighthouses which have extorted from Casimir Delavigne his poetical homage. A pilgrimage to this point is made all the more willingly that the pilgrim who accomplishes it must necessarily pass through Sainte-Adresse, and Sainte-Adresse —need we remind the reader?—is one of the marvels of Normandy.

"The delicious vale of Tempe, which the poets of all time have pleased themselves with investing in the riches of their imagination, possesses no attraction which the valley of Sainte-Adresse need envy: its limpid waters, the gently sloping hills which enclose it, the little gardens where for once the hand of Art has not defaced and desecrated the work of Nature; the pure ethereal freshness which it inhales from the breath of its myriad flowers, and which the wind of the plain never respires;—all charms, all seduces, and we exclaim, Happy he who can spend his life in an abode which Flora and Pomona embellish! The goddess Hygeia resides there throughout the year, and, by a happy alliance with Boreas, both contend for the pleasure of protecting this new Eden against the hideous host of human infirmities. Painters, seize your brushes, and let its image revive on your imitative canvas; poets, come hither in quest of inspiration!"

It is thus that Morlent expresses himself in his "Monographie du Havre." It is true that Morlent—as the reader will conjecture—wrote in 1825. Since that date many things have greatly changed—the descriptive style as well as the valley of Sainte-Adresse, which is no longer anything else than a suburb of Havre, covered with edifices of a more or less picturesque character.

The most curious thing which Sainte-Adresse has preserved is the story of the origin of its name. Namely: that a vessel driven by the currents into the immediate vicinity of the promontory of La Heve, which then extended a greater distance into the sea, was on the point of perishing. Already the despairing sailors had given up further efforts;

the pilot, having abandoned the rudder, imitated the rest of the crew, and commended his soul to St. Denis, patron-saint of Caux,* whose spire was at intervals visible through the haze. "My friends," said the captain, who in these circumstances had retained his presence of mind, "it is not St. Denis we must invoke, but *Sainte-Adresse* (St. Skill), for it is only she who at this crisis can carry us safely into port." The sailors regained courage; the ship entered Havre; and the phrase "Sainte-Adresse" became everywhere popular.

In reference to La Hève, the great writer, Bernardin de Saint-Pierre, a native of Havre, relates a fantastic legend:—

"The Seine"—it is Cephas, one of the personages of *the Arcadia*, who speaks—"the daughter of Bacchus and nymph of Ceres, had pursued into the land of the Gauls the goddess of wheat, when she was seeking all the earth over for her daughter Proserpine. When Ceres had terminated her wanderings, the Seine begged of her, as a reward for her services, the meadows through which the river at present flows. The goddess consented, and granted, moreover, that wine should grow wherever the daughter of Bacchus planted her feet. She left then the Seine upon these shores, and gave her as her companion and follower the nymph Heva, who was bidden to watch beside her, for fear she might be carried away by some god of the sea, as her daughter Proserpine had been by the god of Hades. One day while the Seine was amusing herself on the sands in quest of shells, and when she fled,

* Saint-Denys-Chef-de-Caux was formerly the port of the town now called Sainte-Adresse. Here Henry V. disembarked, in 1415, when he laid siege to Harfleur. But the sea, gradually encroaching on the Cape, has destroyed the village, the port, and the church where St. Denys was worshipped.

with loud cries, before the blue sea-waves which sometimes wetted her feet, Heva, her companion, discovered under the waters the white locks, the empurpled visage, and azure robe of Neptune. This god had come from the Orcades after a great earthquake, and was traversing the shores of Ocean, examining with his trident whether their foundations had been shattered. On seeing him, Heva shrieked loudly, and at her warning cry the Seine immediately fled towards the meadows. But the sea-god had also descried the nymph of Ceres, and moved by her brightness and charming mien, he drove his sea-horses in swift pursuit. Just as he was on the point of overtaking her, she cried upon Bacchus her father, and Ceres her mistress. Both heard her; and as Neptune stretched forth his arms to seize her, all the body of the Seine dissolved into water; her green veil and vestments, which the winds fluttered before her, were changed into emerald waves; she was transformed into a river of the same colour, which still finds a pleasure in winding through the scenes she had loved in her days of nymph-hood: but what is best worthy of notice is, that Neptune, despite the metamorphosis, has never ceased to love her, as is also said of the river Alpheus with regard to the fountain of Arethusa. But if the god of ocean has preserved his passion for the Seine, the Seine still cherishes her antipathy to him. Twice a day he pursues her with awful roar; and each time the Seine flies from him into the green inlands, ascending towards her source, contrary to the natural course of rivers.* And ever she

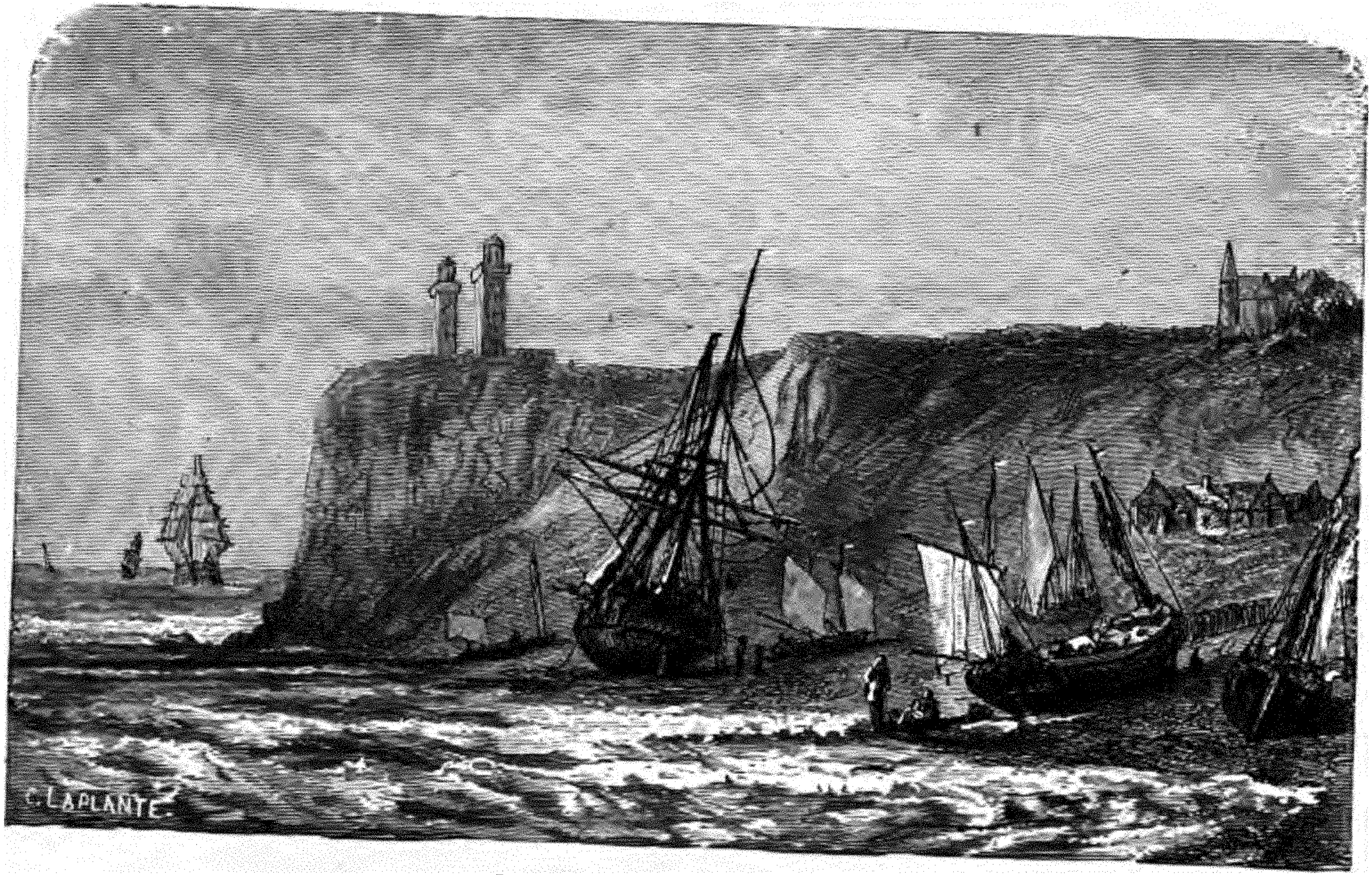
* It is almost unnecessary to say that Saint-Pierre here refers to the *mascaret*, or "bore," of the Seine.

separates her green waters from the cerulean billows of ocean.

"Héva died of sorrow for the loss of her mistress. But the Nereids, to reward her for her fidelity, raised to her memory on the shore a tomb of black and white stones, which are visible from a great distance. By a celestial artifice, they also enclosed in them an echo, that Héva, after her death, might both by sight and hearing forewarn the sailor of the dangers of the sea. This tomb is yonder precipitous mountain, composed of funereal strata of white and black stones. It still bears the name of Héva."

Cape La Hève, the ancient promontory of the Caletes, is one of the jetties, or breakwaters, of the great embouchure of the Seine; in the tenth century, it extended far into the sea, and made an integral part of the bank of l'Eclat, which is now separated from it by a channel upwards of 2000 yards in width. The bank, as its name indicates, has been broken up by a sudden eruption of the currents, or by an earthquake. Nor has ocean ceased its ravages, for it is calculated that its waters encroach seven feet upon the land every year.

If we may credit an old chronicle, the origin of the two lighthouses of La Heve is very ancient. They date back to the epoch when Harfleur was the rendezvous of Spanish fleets. The tower which then surmounted the groyne (*groing*) of Caux had been constructed in 1364; a fire was kindled on its summit in all weathers, and it was called the *Tour des Castillans*. Not a vestige was extant when the incessant representations of merchants and seamen determined the Government of Louis XV. to comply with the



LIGHTHOUSES OF CAPE LA HEVE.

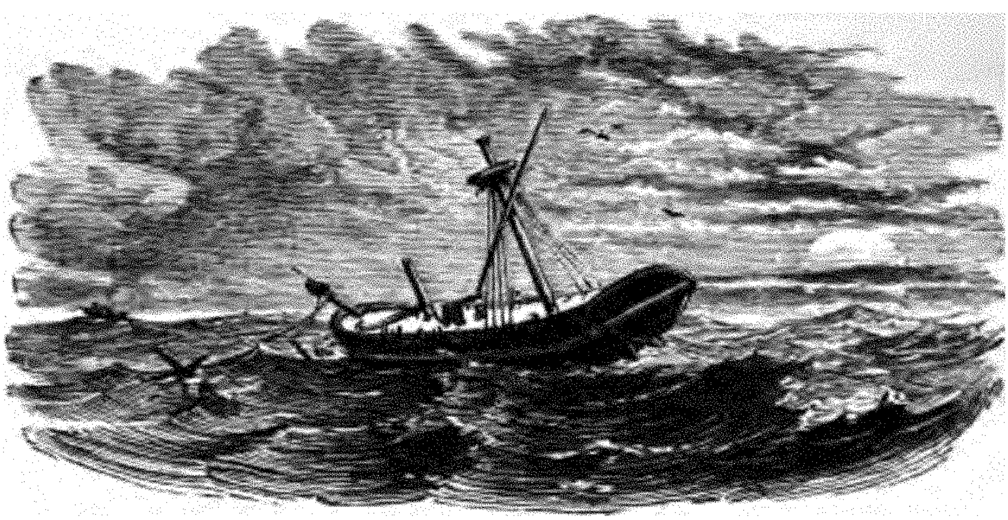
instance of the Chamber of Normandy by constructing the lighthouses which now illuminate the port of Havre.

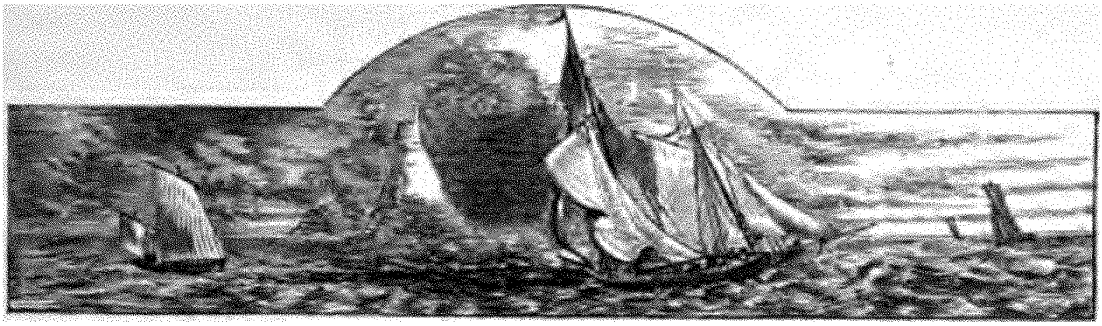
The buildings represented in the accompanying illustration were erected in 1774. Surmounted at first by *chauffers* in which coal was burned, each of them was crowned in 1781 by a lantern containing an illuminating apparatus of sixteen spherical reflectors, some lit up by three, and the others by two broad wicks. There were forty burners in the apparatus. The double paraboloidal reflectors of Bordier-Marceat, six to each lighthouse, were substituted for these faulty appliances in 1811 and 1814, and their number increased to ten in 1819. Finally, in 1845, the towers were restored and modified in their superstructure, so as to fit them for receiving the lenticular apparatus, and lanterns of 12 feet in diameter.* In the meantime, suitable dwellings for the light-keepers were erected between the two towers. Each keeper has two apartments, a closet, a store-room, and a wood-shed, which stands in an enclosed court. He is not, therefore, indifferently accommodated.

The elevations of the La Hève lighthouses present a very imposing appearance. The view from their summit is singularly impressive, and has even been compared by travellers to that of Corinth and Constantinople. When the air is clear, and the sky unclouded, the spectator can see as far as Barfleur on the south-west; on the west, Honfleur, Trouville, and the little picturesque bathing

* These towers have recently undergone another alteration, and are now lit by the electrical apparatus; giving a light equal to 5000 Carcel burners, and visible for upwards of 27 miles.

places on the Normandy coast: Villers, Houlgate, Cabourg, Beuzeval; and finally, in the remote distance, La Hogue, the scene of Admiral Russel's celebrated victory. To the north, he discerns the Cape of Antifer, and the rent and sombre rocks of Etretat.





CHAPTER III.

THE LIGHTHOUSE OF THE HEAUX OF BREHAT.

A.D. 1836–1840.

ONE of the most important of the French lighthouses is that whose brilliant fixed light radiates nightly over the vast and dangerous space comprised between the coast of Brittany and the Roches-Douvres. In our opulent cities it would be considered a monument of the first rank, and its celebrity would, perhaps, rival the renown of the towers of the Eddystone and the Bell Rock, if, like them, it numbered as many years, and had been erected at an epoch when engineering science was less advanced than is the case in the present day.

As a matter of justice, however, we may remark that, notwithstanding the self-reliance of its celebrated constructor, when he cast the foundations of his edifice on the formidable rocks of the Epees de Tréguier—notwithstanding his thorough acquaintance with the labours of his predecessors—M. Léonce Reynaud found himself called upon to meet and conquer difficulties scarcely less numerous or less arduous than those so successfully vanquished by a Smeaton and a Stevenson.

These obstacles were of such a formidable character that the French Lighthouse Commission long hesitated, when deciding on the erection of a lighthouse at the mouth of the gulf which extends between Brittany and the Cotentin, whether its site should be on the mainland or out at sea. The rock on which the choice of the engineers finally rested was part of a group which the sea nearly overwhelms at high tide. It was evident, therefore, that the artificers would only be able to work for a certain number of hours daily. More, the ocean-currents of the region in which it was situated were proverbially very violent; their rate of speed was not less than eight knots per second, and when their force is augmented by the agitation of a tempest, the billows rage with excessive and formidable fury, swelling to enormous heights, and filling the air with their clash and clangour.

Nothing daunted by these difficulties, our engineers set to work, and commenced the erection of the workmen's sheds. These were planted on the isle of Brehat, at about three leagues' distance from the rock. In addition to the fact that this island possesses numerous perfectly sheltered harbours, it is placed by the currents under quite peculiar conditions with respect to the rock of the Heaux: the ebb-tide swings from the island to the rock, and the flood rushes from the rock to the island; and it is exactly at low water that disembarkations must take place. Finally, the island presented all the resources desirable for the accommodation and provisioning of the numerous artificers whose services were called into requisition by so considerable an undertaking.

In one of the havens a jetty of rough stones, about 170 feet in length, was constructed, to facilitate the embarkations and disembarkations, which would necessarily be very frequent. The harbour, that of La Corderie, was exactly opposite the Héaux. In addition to the boats which transported to the rock the materials prepared *in* the island, a very large flotilla was employed in conveying the rough materials, drawn from all quarters, *to* the island. The granite came from the Ile-Grande, situated about ten leagues to the westward; the lime from the basin of the Loire; Saint-Malo furnished the timber; and, finally, as the wells of Brehat did not supply sufficient water for the additional population and the uses of the artificers, water, as well as provisions, was obtained from the mainland.

Sixty artificers formed the "army of labour" organized to carry out all M. Reynaud's bold designs. Lodgings had to be provided for them, inasmuch as the navigation was too uncertain, and the time during which boats could anchor much too short, to admit of their being daily carried back to the mainland. Fortunately, at a very short distance from the place chosen for the works, two aiguilles, or needle-rocks, were found, sufficiently elevated to remain constantly above the level of the water. The interval between them was filled up partly with rough stones and partly with masonry, until an elevation of thirteen feet above the sea was secured; and a platform was thus constructed sufficiently durable for the purpose to which it was intended to put it. Here were planted the huts of the men, and the framework of a beacon which was to carry a provisional light. You may suppose, gentle reader, that there was no room to be wasted. In the beacon was placed, besides the store-room and the keeper's lodgings, the chamber for the accommodation of the engineer; his bivouacking hut was on the right; by blowing up a portion of the rock, a long but narrow apartment was obtained for the overseers; on the left, in front, stood the kitchen and larder; at the side, the workmen's dining-room; behind, their sitting and bed-room, which was well filled. The beds were placed as close to each other as possible, in two tiers. A third range was situated in the refectory, above the table. And, lastly, on a projecting crag, to the left, means had been found to erect a small forge, which had but one defect, that it was often impossible to keep it lighted at high water.

At first the workmen were allowed to supply themselves as they pleased with provisions; but some cases of scurvy having broken out, the engineer felt the necessity of enforcing upon them a regular bill of fare. For this purpose he established a canteen, and bound down its owner to keep a stock sufficient for six weeks' supply, as a precaution against possible bad weather, which might cut off all communication with the mainland. At this canteen each workman was compelled to obtain his rations. Other hygienic measures were adopted. The hammocks were every morning exposed in the open air, and once a week the lodging-rooms were lime-washed. Once a week, too, the whole company bathed. Thanks to these precautions, the terrible malady whose approach had been apprehended was driven from the island, and the sanitary condition of so great a number of men herded together in a very limited compass remained constantly satisfactory.

Every day, as soon as the tide had ebbed, the artificers repaired to work, and the hours for meals were so arranged that no interruption took place while the tide lasted. When the rising waters forced them to abandon the rock, a bell gave the signal. They then hastened to cover with a cement which hardened instantaneously the portions of masonry which had just been finished, and took refuge in their abodes. Sometimes, however, it would happen that the sea rose with unusual rapidity; woe, then, to the tardy! They had no other resource but to throw themselves into the water before its depth became dangerous; an amusement for the on-lookers, and almost their only one. Thanks to these measures of order and supervision, the engineer had not to regret the loss of any of the members of his laborious little colony; although, during the course of their works, many ships, and, still more unfortunately, several visitors, perished.

Let us now say a few words respecting the work itself.

The principal difficulty of the operation consisted in erecting the submarine portion of the building. Once the level of high-water mark was reached, the men could not only carry on their labours more conveniently, but were relieved from the most critical chances. Thenceforth they had nothing further to do with the sea than as regarded the process of landing, and to a certain extent they built upon an island. But on this artificial island everything depended, and in its formation every precaution had to be studied.

The rock on which the lighthouse rests consists of an extremely hard and resistant black porphyry. Nevertheless, as in some places it showed numerous fissures, the work began with the removal of all the superficial part, so as to secure a properly sound basis; and as, at the same time, it was of great importance that the foundation should never be exposed, M. Reynaud adopted the necessary measures to sink it completely in the rock. With this view, an annular surface of 38 feet in diameter, destined to support the hewn stone work, was excavated in the porphyry to a depth of about twenty inches, and dressed with the utmost exactitude; a labour of excessive difficulty on account of the tenacity of the rock, but a certain safeguard against future danger. In the groove thus protected by the whole mass of porphyry were deposited the first courses. As for the part of the rock corresponding to the interior of the tower, no special necessity for extra precautions existing in respect to it, it was left in its rough state, with simply a layer of concrete.

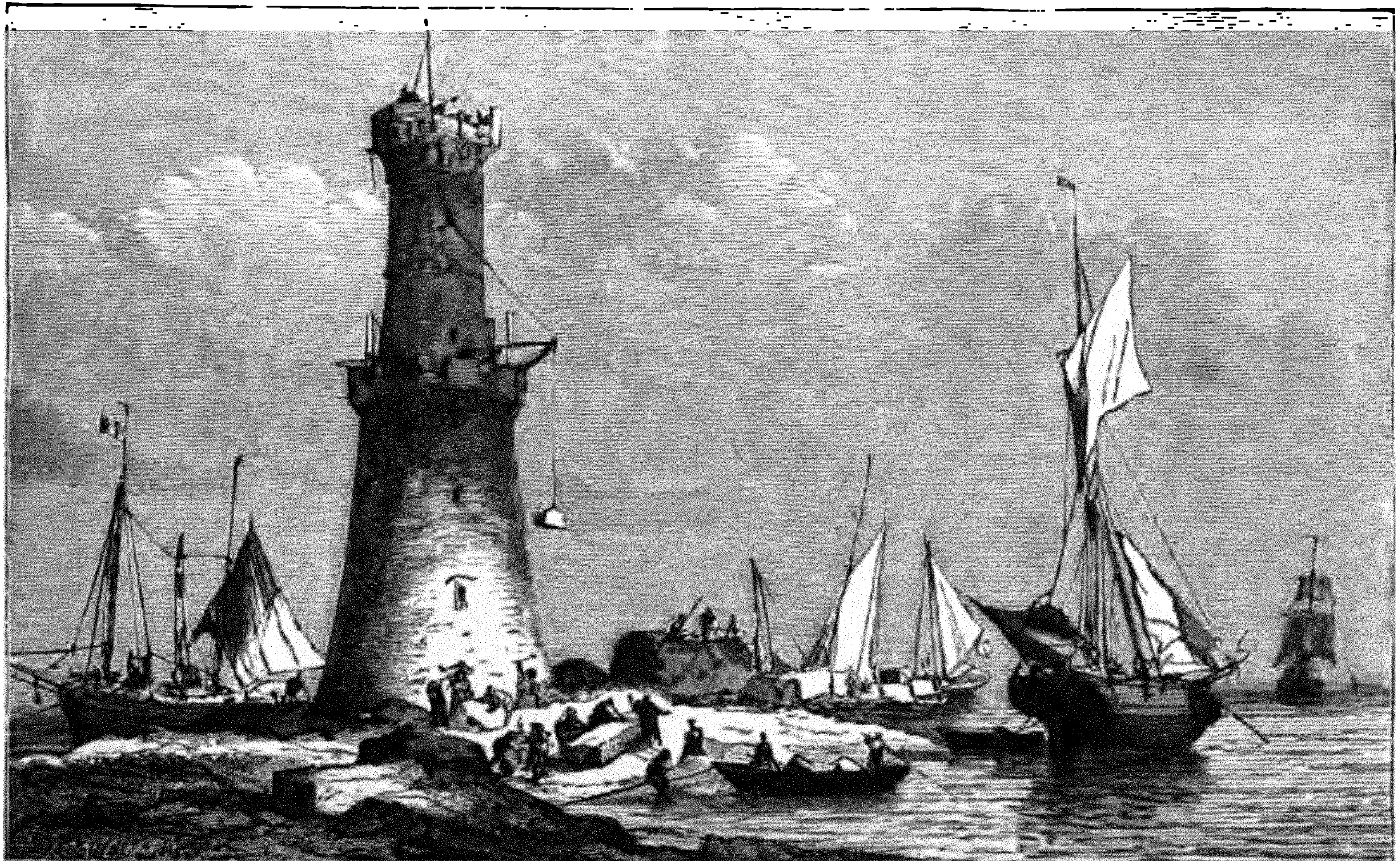
With a view to that stability which has become for the engineer a principle of elegance, the building, 155 feet in height, has been divided into two principal parts. The first, concave at its base, is of solid masonry up to three feet three inches above the level of the highest tides; its diameter at the base is 38 feet, and at its summit 28 feet. The second, reposing on this impregnable foundation, presents that measure of lightness which would have been considered suitable for a tower of the same elevation built upon the mainland. The thickness of the wall is 50 inches below, and 30 inches above.

As for the methods adopted by the architect, it does not seem necessary to describe them in detail; they would only prove interesting to readers of scientific acquirements. Yet we feel disinclined to pass over in silence a bold conception which does honour to M. Reynaud; namely, that, contrary to a generally accepted idea, it is not necessary in works of this kind to bind together all the stones as a whole, under a supposition that the sea may sweep them away during or after the execution of the works. Thus, in the lighthouses of the Eddystone and the Bell Rock, all the stones in the lower courses are dove-tailed into one another after the most ingenious designs, and held together by plugs of iron and wood. Unquestionably, says Reynaud, these arrangements are not without efficacy; but it is doubtful whether sufficient reasons for them exist. Perhaps they even present more inconveniencies than advantages, for, in addition to their cost, they necessitate a troublesome delay in the execution of works which it is of importance to raise as rapidly as possible above the level of the sea.

The architect of the lighthouse of the Héaux has not, then, fixed each single stone; he has confined himself to arresting at certain points the total mass of water which he supposed might be set in motion during each tide. Consequently each layer was divided, for this purpose, into a certain number of portions; twelve for the lower, and eight for the upper courses. All the stones of these great key-stones rested one upon another by means of salient and re-entering edges; and, more, those of the angles were securely fastened to the course beneath by plugs of granite. Experience has proved this simple arrangement to be sufficient; no injury has occurred to contradict the principle on which it was founded.

Such are the means by which this almost unequalled pharos of the Héaux was completed. It occupied six years in erection. The first was employed in examining the localities and perfecting the plans; the second, in the establishment of the cabins and the formation of the groove in the rock; the third, in the construction of the solid masonry; during the fourth, the tower was raised as far as the first gallery; in the fifth, a little above the cornice; finally, in 1839, the lantern was fixed and lighted. The monument bears the following inscription: "This edifice, commenced in 1836, was completed in 1839, in the reign of Louis Philippe."

Rapid and successful as was the work, it was nevertheless marked by some accidents. At the commencement of the campaign of 1836, all the machines were in their places, and preparations were being made to lay the first stone, when the whole was swept away by an extraordinary wave. We have heard the engineer describe the cruel regret he experienced on arriving at the rock, after having been separated from it for three days by the tempest, and discovering all his works prostrated, most of his artificers wounded, the whole of them demoralized, and in the midst of the confusion the seamen, who had never been willing to believe in the feasibility of the matter, laughing aloud. He did not lose his courage, and skilfully revived the ardour of his men at the same time that he raised anew his apparatus. A "crab" was planted on the precipitous rock, at whose foot the barges brought alongside, and the materials were transported with the assistance of a railway

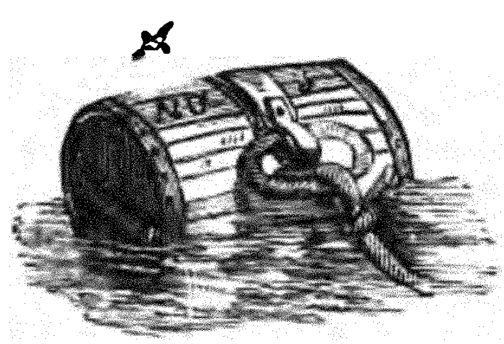


ERECTION OF THE LIGHTHOUSE OF THE HEAUX

laid down on the precipice which separated this natural landing-place from the site of the tower.

Alone, in the midst of ocean, the lighthouse of the Héaux of Brehat acquires, by its very isolation, a character of severe grandeur which profoundly impresses the voyager. As Michelet says, it has the sublime simplicity of a gigantic sea-plant. Enormous, immovable, silent, it seems, in truth, a defiance flung by the genius of man in the teeth of the spirit of the storm. Sometimes, says M. de Quatrefages, you would say that, sensible of the outrage, the heavens and the sea league together against the enemy who braves them by its impassability. The impetuous winds of the north-west roar around the lantern, and hurl torrents of rain and whirlwinds of hail and snow against its solid crystal. Under the impulse of their irresistible breath gigantic billows hurry up from the open sea, and sometimes reach as high as the first gallery; but these fluent masses glide over the round polished surface of the granite, which does not offer them any holding-place; they even fling long streams of foam above the cupola, and dash down with a groan on the rocks of Stallio-Bras or the shingly beach of the Sillon. But without a quiver the lighthouse supports these terrible attacks. Yet it bends towards them as if to render homage to the power of its adversaries. The keepers have assured me that during a violent tempest, the oil vessels, placed in one of the highest chambers, show a variation in level of upwards of an inch, which supposes that the summit of the tower describes an arc of more than a yard in extent. For the rest, this very pliancy may be regarded as a pledge of durability. At least, we find it in numerous monuments which have braved for centuries the inclemencies of the season. The spire of Strasburg Cathedral, for instance, curves, under the breath of the winds, its long ogives, and its graceful little columns, and balances its four-armed cross, elevated 440 feet above the soil.

The keepers of the lighthouse of the Héaux did not deceive M. de Quatrefages. Observations made in other lighthouses, erected in the open sea, confirm the statement they made to him. If these monuments of human skill and industry are 130 feet in height and upwards, their agitation becomes sufficiently perceptible to spill any liquids in uncovered vessels, to shake the movable weights of the mechanism, rattle against the sides of the descending tubes, and, in a word, to suggest to visitors a vivid idea of the roll of a ship. Towers built after this fashion are, in fact, reeds of stone which bend before the wind; but, like the reeds, they raise their heads again as soon as the hurricane has passed.



CHAPTER IV.

THE GRAND BARGE D'OLONNE.

A.D. 1861.

WE must not take leave of French oceanic lighthouses—that is, of lighthouses built out at sea—without a brief reference to that of the Grand Barge d'Olonne. Situated on a rock of shoal about 1.134 nautical miles from the shore, in a situation surrounded by obstacles of every kind, where the currents are excessively violent, and where the tempests so disturb and madden the sea as to render nugatory all known methods of construction, this lighthouse does the greatest honour to its architects.

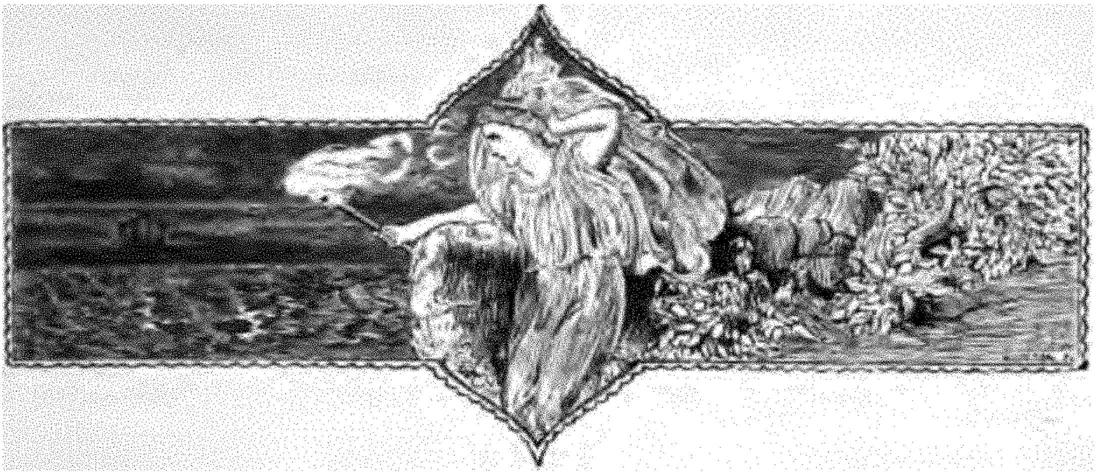
Its foundation is almost completely submerged, and during high tides the waves leap to a height, it is said, of 100 feet.

The work was undertaken in 1857, and completed in 1861; but such were the difficulties offered by the nature of the locality, that in these five years only one thousand nine hundred and sixty hours could be devoted to consecutive labour. Yet, so familiar are now the principles on which edifices of this nature must be constructed, or —to speak more justly—so confident in their own resources are the engineers who devise and erect them, that even this comparatively brief period proved amply sufficient.

The entire cost of the work was 450,000 francs, or £18,000. It was executed under the direction of M. Reynaud, inspector-general, and M. Forestier, engineer-in-chief. The tower is built of granite, the stones of the face being mortised and tenoned together; its diameter at the base is 39.37 feet, tapering with a curved outline to 21.23 feet at the upper part. The door-sill is 13.12 feet above high-water mark of the highest tides, and up to this level the tower, with the exception of a cellar for coal and fresh water, is solid. Above the level the tower is hollow, with an internal diameter of 11.48 feet, and is divided into five stories by vaults of brick. The tower has a stout cornice and parapet of granite. From the centre of its platform rises the turret, 6.56 feet high, and 8.2 feet in internal diameter, which supports the lantern. The internal diameter of the catadioptric illuminating apparatus is 3.28 feet, and gives a white light with red flashes every three minutes.

The rocky peak on which the "Phare des Barges" stands, rises about one and a half foot above low water of ordinary spring-tides; but at low water of neap-tides is covered to the depth of about two feet and a half.

It is situated to the westward of the port of Sables-d'Olonne.



CHAPTER V.

THE LIGHTHOUSES OF WALDE, THE ENFANT PERDU, AND NEW CALEDONIA.

A.D. 1859—1863—1865.

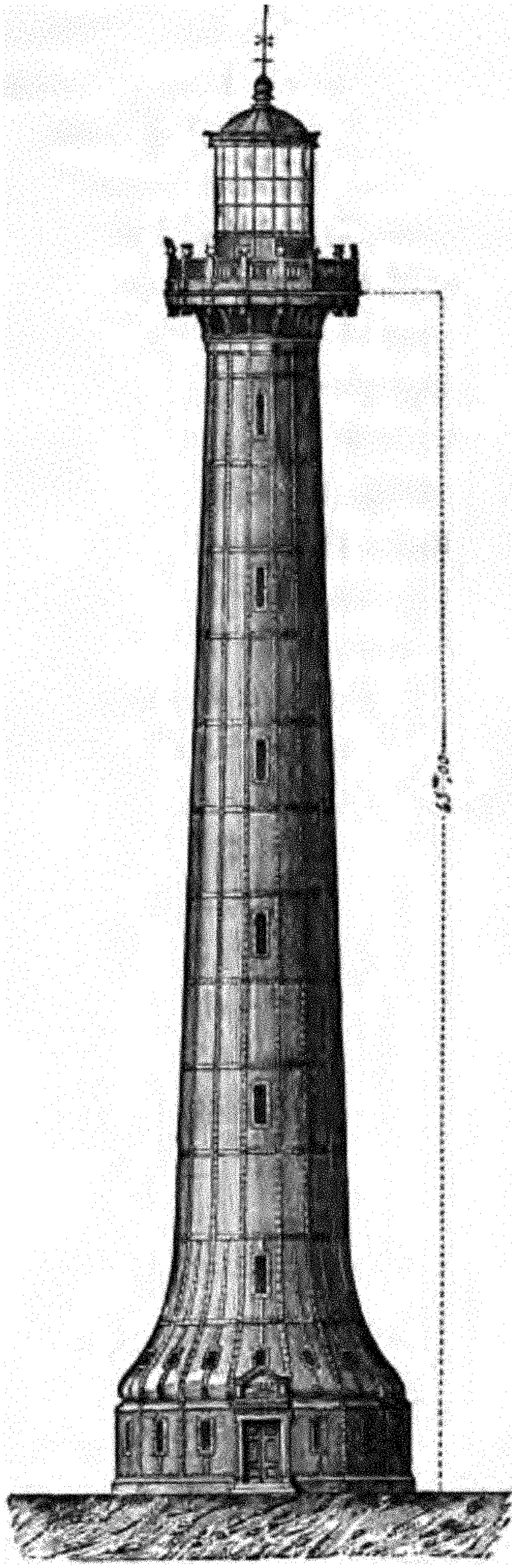
WE have spoken of the patriarch of the French lighthouses, the venerable Tower of Cordova; it would be unfair to forget the youngest of the family, that of New Caledonia. Independently of the services which it renders in the region it illuminates, this edifice has, so to speak, a physiognomy of its own: it is built of iron, and structures of this material are sufficiently rare to justify us in devoting a few lines to its description.

Iron is not so suitable as stone for the construction of lighthouses; it is not so durable, it is more expensive in working and repairing, and it affords a less efficacious protection against the thermometrical variations of the atmosphere. Yet under certain circumstances our engineers gladly have recourse to it. It has given rise to various systems of construction. One of these, invented by Mr. Mitchell, has been successfully applied in several instances in England; and has been adopted in France for the lighthouse of Walde, kindled in 1859 to the north of Calais, on a sandy shore stretching far out into the sea; and for the lighthouse erected on the rock of the Enfant Perdu (coast of Guiana). It consists of iron pillars protected in the lower part by strong metal screws, strengthened by cross bars and St. Andrew's crosses, and surmounted, at a suitable distance above the sea-level, by a platform which supports the rooms of the keepers. The whole erection is crowned by the lantern.

Since we are speaking of this pharos of the Enfant Perdu, let us say how difficult a task was its construction. "More than once," writes Vivian, the chief engineer of Cayenne, "it was necessary, in order to fix a running hawser for landing purposes, that stout and courageous men should resolutely dash into the sea, and swim with a rope to the shore. The risk of being flung against the rocks was not the least they ran, for, as at the bar of the Senegal, sharks abound in these regions. The ebb and flow render navigation very difficult; more than one of the men were wounded, and we may say that all sported with their lives."

Yet here, as elsewhere, resolution, industry, and perseverance have triumphed over every obstacle.

The framework of the pharos at Port de France, New Caledonia, like that of the Roches-Douvres, is made up of sixteen uprights, each composed of fourteen pannels. Each pannel is formed of T irons, consolidated and riveted together in such a manner as to be perfectly firm—an object fully attained, for the oscillations experienced in lighthouses of stone are in this scarcely discernible. These pannels are pinned one upon another, while cross bars applied both within and without, and likewise pinned, keep the uprights in their position. Finally, on these latter cross bars, and on the inner sides of the uprights, rest the plates of sheet iron constituting the walls, or sides, whose joints are covered by iron platbands, fixed by bolts.



LIGHTHOUSE AT NEW CALEDONIA.

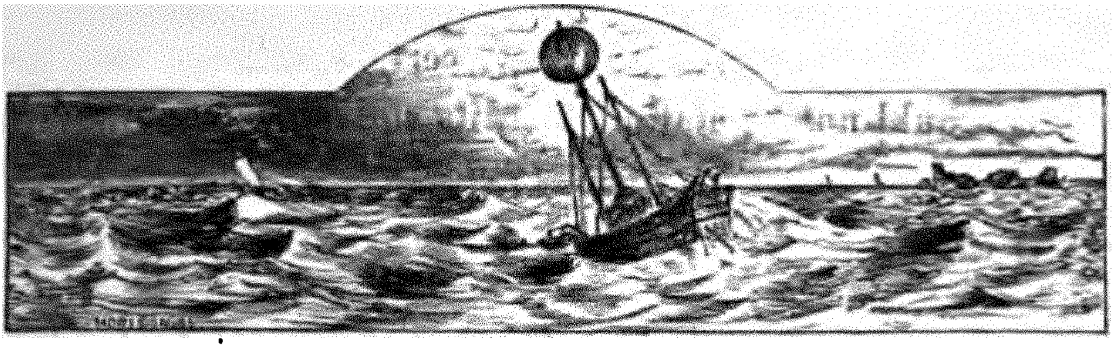
The height of the New Caledonia lighthouse is 164 feet, or 170 feet if we measure from the base of the tower to the point of the lightning-conductor. Its apparatus is of the first class, lenticular, with a fixed white light, whose range is twenty-two miles The spot on which it is raised is an island of sand, such as the coral animals form in so great and dangerous a number in the southern seas, and is situated to the south west of Noumea.

Constructed at Paris, and transported in pieces to the Antipodes, the pharos of

New Caledonia was inaugurated on the 15th of November 1865, with all the ceremonial appropriate to so important an event. After the benediction of the monument by the priests of Noumea, M. the Commandant Guillain pronounced a discourse, from which we extract the following passage:—

"If, transporting ourselves in thought into the different regions of the civilized world, we examine the events transpiring there, the most magnificent panorama is unrobed before our eyes. Everywhere,—and this will be the glory of our epoch,—everywhere, great works are being executed to bring the peoples together, to multiply their relations, to prepare, in a word, that universal brotherhood, destined and reserved by Providence for future generations."

The savages, attracted by the brilliancy of the festival, mingled with the French soldiers, seamen, and colonists. Did they understand this wise and noble speech? We fear not. But Time marches onward for them as for us, and Time, which has already destroyed their horrible custom of cannibalism, will one day explain its full meaning to them. Nor is this glorious epoch far remote; wherever beams the lighthouse-lamps, the sails of rich argosies whiten the horizon, wafted from sea to sea by the powerful impulses of civilization!



BOOK V.

THE AUXILIARIES OF LIGHTHOUSES.

CHAPTER I.

FLOATING LIGHTS: LIGHTSHIPS.

LIGHTHOUSES form the *first* line of the coast defences which man raises for his protection against the fury of the ocean. But there are many parts of the coasts of every maritime country which are unsuitable for their construction, whether they be built of stone or iron, and which, nevertheless, stand greatly in need of illumination. In England, especially, these points are numerous. Among others, we may refer to the Goodwin Sands—that fatal tract off the shore of Kent which has been the destruction of so many "tall ships" and "adventurous mariners," whose name has for centuries been associated with the memory of the most deplorable disasters. On the entire coast of England there is probably no other locality so fatally connected with dismal stories of human suffering, and yet it was long impossible to warn the sailor from it by any certain agency. Lighthouses could not be stationed on its shifting sands; and it seemed as if this one wild waste must of necessity be abandoned to the pitiless winds and not more compassionate seas. However, towards the close of the last century, the idea occurred to one Robert Hamblin of substituting floating lights for fixed lights—a light*ship* for a light*house*.

Robert Hamblin was an experienced and reputable barber of Lynn, who had married the daughter of a shipowner of that busy little seaport, and in due time had become master of a vessel. He was engaged in the coasting trade—in carrying coal from Newcastle to other ports—and was thus well enabled to judge of the inadequate manner in which the eastern coast was lighted. Accident, after a time, introduced him to a man whose brain was full of grand projects, but who was cruelly hampered by poverty—David Avery; and the two, combining their resources—the one finding the money, the other the intellect—established at the Nore a floating light on board a ship, and assumed a right of levying tolls for the maintenance of this new pharos (A.D. 1732).

It was impossible that the Trinity House could regard this assumption as other than an infraction of their legal privileges, though they were compelled to own that the lightship was successful, and that it proved of great assistance in the navigation of the intricate estuary of the Thames. Encouraged by the triumphant issue of his experiment, Avery boldly announced his design of placing a similar vessel among the waters of the Scilly Islands. The corporation of the Trinity House, in their capacity of protectors of British commerce, then laid a complaint before the Lords of the Admiralty; who, however, were either unwilling or unable to act. They next addressed themselves to the Crown, representing that it was illegal for any private individual to levy a tax on the mercantile marine; and acted with so much energy as to obtain a royal proclamation prohibiting the light at the Nore. Avery, whose schemes of acquiring almost boundless wealth were thus rudely broken up, appeared in person before the Board, and proposed to treat with them in reference to the Nore light. He asserted that he had expended a sum of £2000; and his offer was, that all right and title to the floating ship should remain for ever in the hands of the Trinity House, but that the tolls should be levied by him and his heirs for a period of sixty-one years, on payment of a yearly sum of £100. These terms were accepted.*

Such, briefly told, was the origin of LIGHTSHIPS.

The lightship, be it understood, is not employed only to indicate the position of a sand-bank, but as a beacon against perfidious currents, submarine whirlpools, or reefs which are hidden at certain hours by the high tide. We borrow from the lively pages of M. Esquiros a sketch of this most useful vessel:—

When first seen, and especially if seen from a distance, a lightship closely resembles during the day an ordinary barque. But if examined from a nearer point of view, a very great difference between the two is readily discernible. The lightship floats, but it does not move; its short stout

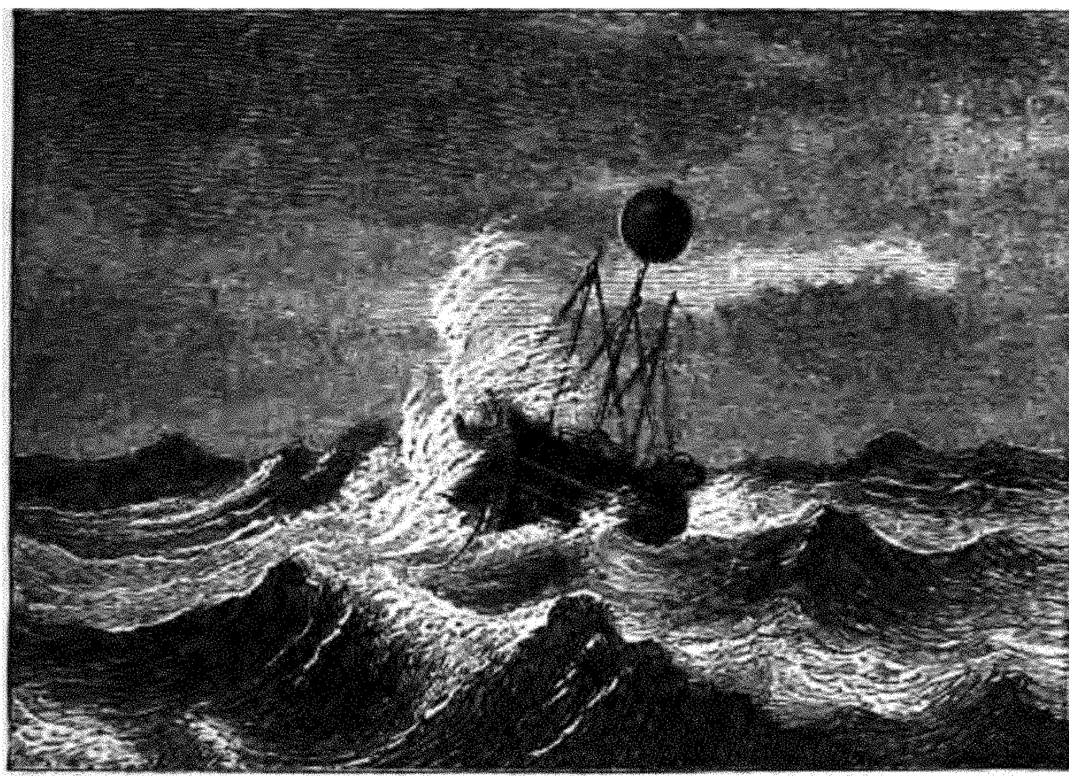
* The second light-vessel established off the British coast was the *Dudgeon* (Lincolnshire), in 1736.

masts are without sails, and surmounted by large balls. Other ships represent motion; this, immobility. We ask of vessels, as a rule, that they shall obey the wind and the wave; we ask of the lightship that it shall resist them. What, indeed, would happen if it drifted before the gale? Like a meteor, the wandering light would deceive the pilot, instead of warning him. A ship which does not navigate—a fixed and fettered ship;—such is the ideal which the builder of the light-vessel keeps ever before his mind; and this ideal has naturally troubled the imagination of naval architects in more than one direction.

The form of the lightship varies according to its locality: in Ireland the hull is more elongated than in England; but in all cases the object to be attained is the same—resistance to the force of the winds and waves. It is desired that in the most violent tides, in the midst of the angriest billows, and in situations the most exposed to the influence of the currents, it shall drag as little as possible upon its anchor. That it may at all times and in all conditions preserve the same maritime position, it is securely moored. Like a galley-slave, riveted to an iron chain, it can move neither to the right nor to the left. The length of its cable is, of course, regulated by circumstances: at the Seven Stones, where it rides in 240 feet deep of water, it measures upwards of a third of a mile in length. Some years ago it was found that the addition of certain ingenious shackles (so to speak) controlled its movements; and by various improvements in its construction, the result has been obtained that, slave though it be, it shall weigh as little as possible on its mooring-chains. Usually, the moorings consist of a chain lying along the sea-bed for

1260 feet, with an anchor of 32 cwt., in the shape of a mushroom at either end, and a swivel in the centre, to which is attached a veering cable of 630 feet of chain.

Few instances are on record of a lightship having broken loose from its moorings, and none of its having suffered shipwreck. Each vessel carries, for emergencies, two bower anchors of 20 cwt. and 15 cwt.; and cables respectively 1260 and 900 feet long. Nor is it known that



THE LIGHTSHIP.

the crew have, on any occasion, or whatever the fury of the tempest, voluntarily changed their position. If, however, the ship should be driven from its place by the irresistible force of the elements, so that its light may become a source of danger to the mariner, they hoist a red signal and fire a gun, and generally it is soon restored to its normal situation. The peril of drifting, and the presence of mind which the necessary manœuvres require in such an event, are evidences, nevertheless, of the courage and resolution of the men who live, day and night, exposed to the caprice of the seas. As it is necessary to prepare for every accident, a spare vessel is always held in readiness at the head-quarters of each district; owing to the telegraphic network which now surrounds our shores, the slightest mishap is soon made known to the authorities; and often before sunset the reserve ship, towed by a powerful steam-tug, occupies the place of the vessel which the storm has driven from its moorings. The lightships of the Trinity House are painted *red;* those of Ireland, *black*. Experiment has shown that red and black are the two colours which most vividly contrast with the prevailing hue of the sea. The name of the vessel is inscribed in large letters on its sides. A flag, bearing a cross quartered with four ships, waves at the stern. These are the arms of the Trinity House.

Our British and Irish lightships numbered fifty-nine in 1870. Each, like the lighthouse on shore, is distinguished by its own peculiar aspect—by certain differences which assist the navigator in recognizing it, and, consequently, in recognizing the particular danger he is called upon to avoid. Some have one light, some two lights, some three lights. Of these lights many are fixed, many revolving, many coloured. The building and equipment of one of these vessels* will cost from £2000 to £3000. Its maintenance, including the cost of oil, the wages and provisions of the men, amounts to about £1200 per annum.

* The average length is 80 to 90 feet, and the burden from 160 to 180 tons. The *Calshot*, between Southampton Water and the mouth of the Medina (Isle of Wight), is only 100 tons.

The United States stand next to Great Britain in the number of lightships which they support in the interests of commercial enterprise. At one time, however, their organization was very indifferent; but of later years the system followed in England has been adopted with a few unimportant modifications. The American ships are painted in longitudinal stripes of varied colours. In very bad weather they frequently quit their posts, and return into harbour.

France has fewer lightships than either Great Britain or America, and only *five* whose burthen exceeds seventy tons.

Let us now say a few words in reference to the resolute crews who man these vessels.

The crew of an English lightship consists of a master, a mate, and nine men. Three out of the nine are intrusted with the service of the lamps; the six others, who always include among them a good carpenter, attend to the order and cleanliness of the vessel. It must be remembered, however, that the nine men are never all on board together; one-third are always enjoying an interval of rest on shore. Experience has proved that a perpetual sojourn on board a ship of this kind is too much for the moral and physical forces of human nature. The crushing monotony of the same scenes, the eternal spectacle of foam-crested waters rolling wherever the eye is turned, the ceaseless noise of the winds, the everlasting murmur of the ocean —swelling at times into so terrible a roar that it renders inaudible the human voice—could not fail to exercise a depressing influence on the mind. But even allowing for the occasional vacation spent upon land, the life is so uniform and unexciting that it is wonderful any man can be found to endure it; and the crews of our lightships may assuredly be ranked among the curiosities of civilization.

To mitigate the rigours of so strange a profession, the Trinity Board provides that each man shall pass one month on shore for every two months he spends on board; while the captain and the mate change places every month. But grim old Neptune does not always permit this system of reliefs to be regularly carried out. It often happens in winter that the storm and the tide are opposed to every kind of disembarkation; and between the lightship and the Scilly Islands, for instance, weeks elapse before the communication can be re-established. The men ashore are occupied in cleaning cables, painting buoys, filling the oil tins, and similar duties. We know not whether what was acknowledged by an old lightship "hand" is true of all; that all the time he was on land, he dreamed of the sea; all the time he was on board the lightship, he dreamed of the land.

The visitor of an English lightship cannot fail to be struck with its admirable condition, and with the fine appearance of its crew. Sun-tanned and weather-beaten, they are models of English sailors: frank, self-reliant, unassuming, obedient, nimble, vigorous, and resolute. They seem well-contented with their lot, and if they complain at all, it is of the quantity and quality of their provisions. The ration of bread (seven pounds a week) is not quite sufficient for hearty men, and I confess, from my own experience, that the sharp air to which they are exposed is well adapted to whet one's appetite. When they are at sea, their food is supplied by the Trinity House; when on shore, they receive instead one shilling and threepence a day. Their wages are fifty-five shillings per month; the master receives £80 per annum.

Two men at a time are charged with the care of the lamps, the third being on shore; one of these two performs for a month the functions of a cook. Formerly, if we may believe public rumour, the lightship crews, isolated by continual tempests which rendered the sea impracticable, have been reduced to the extremest necessities, have even perished of hunger. To prevent the recurrence of such calamities, a steamboat or a good stout sailing-vessel regularly visits the lightship once a month. In the worst weather the communication is never interrupted for a longer period than six weeks, and the stock of provisions is always sufficient to last the crew for even a longer time.

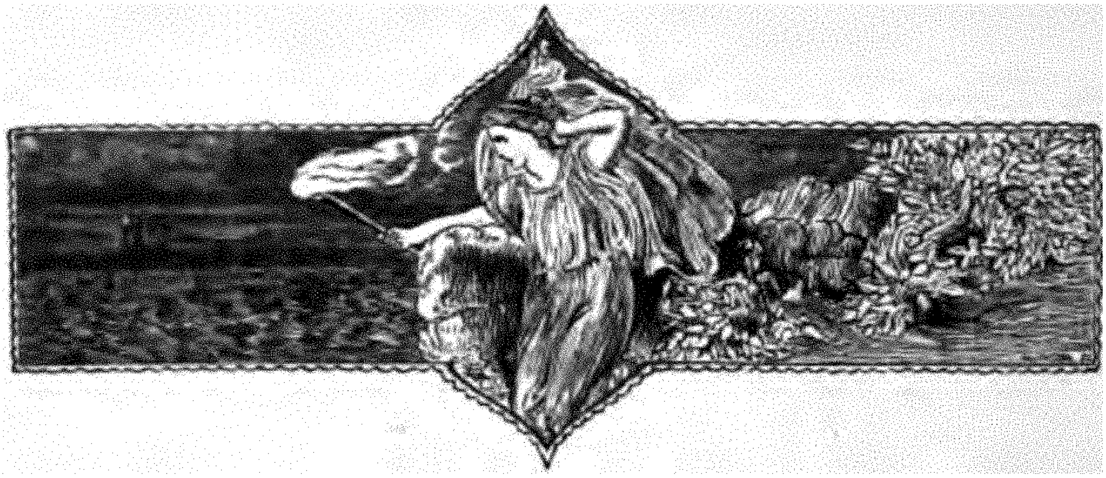
The lanterns in which the lamps are fixed are hung round the mast; during the day they are lowered on deck that they may be cleaned, and supplied afresh with oil; at night, this crown of lights is raised to its conspicuous position by means of a pulley. The ship is also provided with some small cannon and a gong. But, unfortunately, these signals are not always comprehended by foreign ships.

The crew of the Scilly lightship, says Esquiros, have witnessed but two shipwrecks; in the one instance, they saved a single life; in the other, all the passengers, with the exception of the wife of a missionary. It is not, however, a part of their duty to go to the rescue of vessels in danger; and if the authorities admire, for obvious reasons they do not encourage such acts of heroism. Their sole and all-absorbing duty is to take care of the light. The discipline to which they are subjected is severe, and no man may quit his post under any pretence whatever. A sailor, in 1854, having been informed of his wife's death, deserted the lightship, and repaired to London to attend her funeral. He was reprimanded, and it was only in consideration of the motive which had induced his absence that the authorities refrained from discharging him. The lightship of the Seven Stones, off the Scilly Islands, is the most exposed of all the vessels on the British coast;* its captain, however, considers that it rides much more easily on its anchors in a sea where waves are long and regular, than those ships which are moored in seas with short and contrary waves. He will tell you that his gallant barque is always ready for the tempest. And yet its deck is sometimes washed by the waves, and when the sea strikes against its broadside, the roar is like the discharge of a piece of artillery.

On board every lightship the life of the crew is much the same. On Sunday, at dawn, the lantern is lowered, and the lamp-lighter cleans and prepares his lamps for the next night's work. At eight o'clock everybody must be on the alert; the hammocks are hung up, and breakfast is served. Afterwards, the men wash and put on their uniform, of which they are very proud, for on its buttons figure the arms of the Trinity House. At half-past ten they assemble in the cabin, and the captain or mate performs divine service. At sunset the lighted lantern is hoisted up—the real standard of the vessel—and the crew

* Others which occupy dangerous positions are, the Leman, the Ower, the Newarp, the Sunk, and the Kentish Knock.

again meet together for prayer and the reading of the Scriptures. With the exception of the morning and evening services, the week-days close resemble the Sundays. Wednesday and Friday are the chief cleaning days, and the ship then shines with cleanliness. To watch over, and maintain in due order, the lighting apparatus; to keep watch on deck; to note seven times in every twenty-four hours the conditions of the wind and atmosphere; to attend to the condition of the mooring-chains;—such is the almost invariable circle of their occupations. Their leisure time, which is not inconsiderable, they employ in reading. A library is always kept on board, and the books are circulated from hand to hand, and ship to ship. Under such circumstances how miserable would be the condition of a man who could neither read nor write! Yet such is sometimes the case with a few on first entering the service; but whether it be the force of example, or the necessity of overcoming the oppressive ennui of idle hours, it generally happens that, with the assistance of the captain or mate, they more or less repair this absolute want of education. One of the best officers of the company is a man who taught himself reading and writing in order that he might obtain an engagement on board a lightship. The seamen also devote their leisure to all kinds of ingenious manual work, and some of them set to work as shoemakers, joiners, tailors, wood-carvers, and the like.



CHAPTER II.

LANDMARKS, BEACONS, AND BUOYS.

TO complete our account of the defences of our coast, we must refer to works of less pretension than lighthouses and lightships, and of less utility, though still of very considerable importance. They present themselves under various forms, and they have different names, according to their respective positions and objects.*

Let us first direct our attention to landmarks and beacons; by which, in nautical language, we mean every terrestrial object that assists the seaman in calculating his data, and determining his course. The spires of churches, the towers of castles, windmills, tall isolated trees, or rocks of a characteristic configuration, are useful for this purpose. Solitary peaks, like that of Teneriffe—volcanoes surmounted by a canopy of smoke—are gigantic landmarks which assist the navigator in rectifying his geographical position.

Among the very numerous class of landmarks we meet with a few as celebrated as, or even more celebrated than,

* Founded on a chapter in M. Rénard's "Les Phares;" and an article in

the majority of our lighthouses. Such are the Pillars of Hercules—anciently designated the Columns of Saturn or of Briareus — and Pompey's Pillar, near Alexandria. One thing is wanting, however, to the glory of the Pillars of Hercules—that they should have existed. Hesychius, nevertheless, asserts that there were three or four, while, according to Edrisi, six were placed on the sea-coast; the easternmost at Cadiz, in Andalusia; the others in the islands of the Shadowy Seas, as a warning to navigators not to advance beyond them. But Strabo, when speaking of the foundation of Cadiz by the Tyrians, puts forward some doubts as to the accuracy of this statement, and his doubts seem not to have been ill-founded. We believe with him that these famous Pillars of Hercules existed only in the imagination of the writers of antiquity, who were frequently as enthusiastic in belief of fable as of truth.

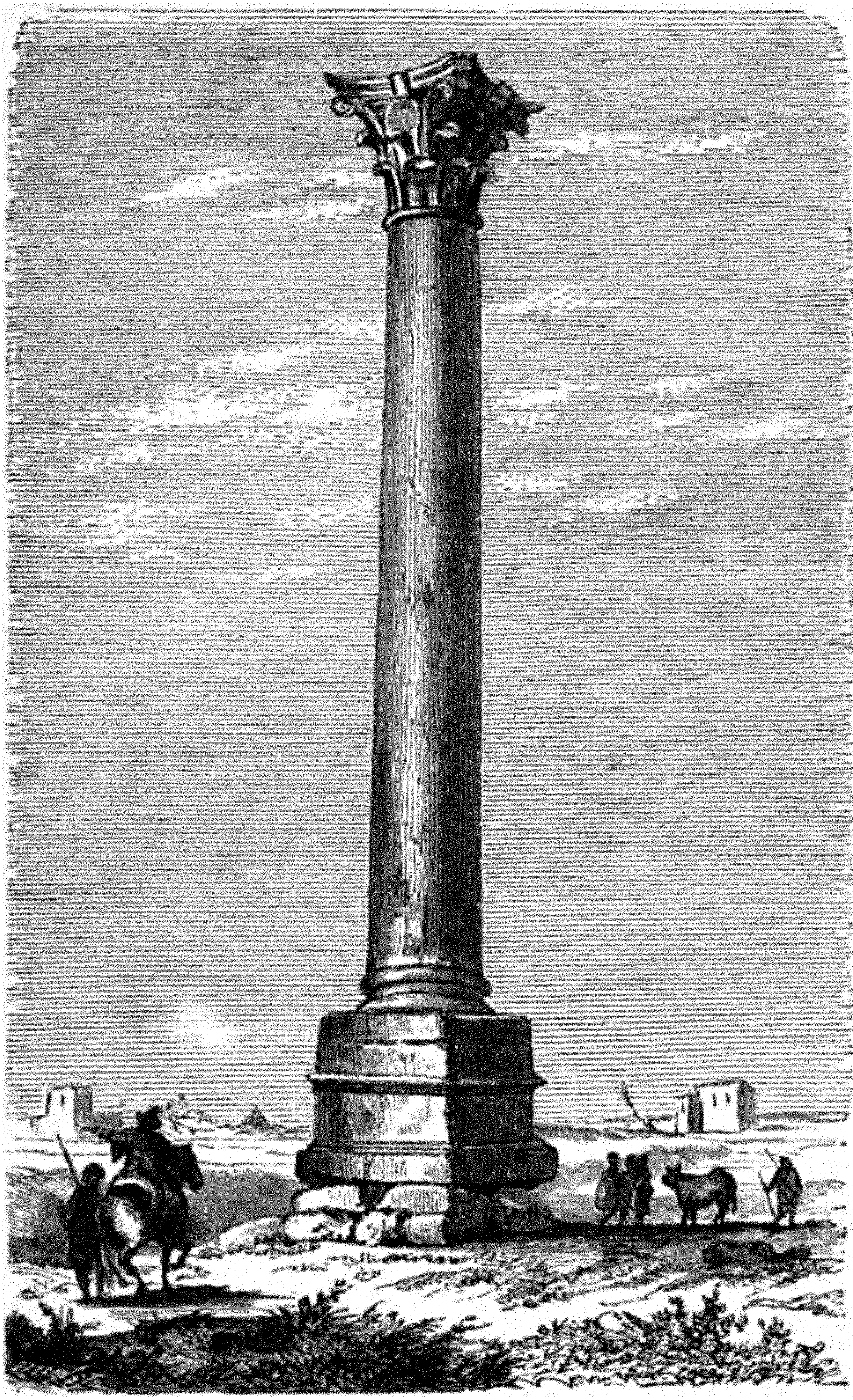
The best known sites of the pillars, whether they were real or fabulous, were at Calpe, on the European shore of the Straits of Gibraltar, and at Abyla, on the African. But *what* the pillars were, none of the ancient authorities are agreed. According to Strabo, some believed them to be rocky headlands, others, islands; the former rising up from the land, the latter starting out of the sea, like gigantic columns. Others, again, understanding the word στῆλαι literally, looked for artificial mounds, or columns, or statues, which Hercules himself had erected to indicate the limit of his conquests, or the Phœnician navigators had dedicated to their tutelary deity, to record the extent of their discoveries.* Strabo informs us that this literal interpre-

* See Article "Herculis Columnæ," in Smith's "Dictionary of Geography," i. 1054.

tation was held by the Iberians and Libyans, who denied that there existed at the Straits anything resembling columns, but pointed out, as the Pillars of Hercules, the bronze columns in the temple of the god at Gades, on which the expenses of building the temple were inscribed. He adds that this opinion was held by Poseidonius, in opposition to the Greeks in general, who considered the pillars to mean *promontories*.

A monument not less famous, and whose existence cannot be doubted, inasmuch as it still answers the purpose of a landmark, is the so-called Pompey's Pillar, at Alexandria. This structure is the first object to attract the eye when you approach the classic shores of Egypt; from afar it dominates over the town, the minarets, the obelisks, and the lighthouse.

Pompey's Pillar—the *Amood é sowari* of the Arabs—occupies the summit of a dreary, solitary mound, which overlooks the Lake Mareotis and the modern city of Alexandria. It may be described as a handsome and stately Corinthian column; the shaft, a monolith of red granite, 73 feet in height; the total height, including capital and base, 98 feet 9 inches; the circumference, 29 feet 8 inches. Its history is involved in considerable obscurity. The Arab chronicler, Abdallatif, represents it to be the sole remaining pillar of the four hundred which once adorned and enclosed the celebrated Serapeion, or Temple of Serapis; the Portico, where Aristotle expounded his philosophical theories; the Academy, which Alexander erected when he founded the city, and where the great library was placed—the glory of Alexandria—erroneously



COLUMN AT ALEXANDRIA (*Known as Pompey's Pillar*).

said to have been destroyed by order of the Caliph Omar.

The Serapeion was razed to the ground at the instigation of a furious zealot, the patriarch Theophilus. Its columns were rent and shattered, and finally piled up, as a break-water, on tho sea-shore—all save the one stately pillar—the loftiest of the four hundred—the "pillar of the colonnades," as the Arabs emphatically termed it—which is still the cynosure of European pilgrims. This was re-erected by Publius or Pompius, prefect of Egypt, and a new capital and base were provided for it; the whole being dedicated, as an inscription on its pedestal records, in honour of the Emperor Diocletian, "the Invincible," and in commemoration of the deliverance of Alexandria from the insurgent bonds of the pretender Achilleus (A.D. 297).

The summit may either have been crowned with a statue, or have simply assisted in sustaining the cupola of the Serapeion.

Pompey's Pillar—as, in defiance of history, men still continue to call it—stands to-day in a wild and dreary waste—widelv different from the scene that surrounded it when, of old, the Nile swarmed with gilded barges, and the waters of the Mediterranean were ploughed by countless argosies, and the flickering glare of the pharos was the guiding star of the commerce of the world. You reach it, as Miss Martineau tells us, through the dreariest of cemeteries, where all is of one dust colour, even to the aloe which is fixed upon every grave. From the base, the view is curious to novices. Groups of Arabs are at work in the crumbling, whitish, hot soil, with files of soldiers keeping watch over them. To the south-east you obtain a fine view of Lake Mareotis, whose slender line of shore seems liable to be broken through by the first ripple of its waters. The space between it and the sea is one expanse of desolation. A strip of vegetation—some marsh, some field, and some grove—looks well near the lake; and so do a little settlement on the canal, and a lateen sail gliding among the trees.

As commerce increased, and flowed into fresh channels, men very naturally multiplied on every coast the landmarks which played the same useful part by day as did the pharoses by night. If we may believe Coulier, we owe to the Etruscans the invention of that system of beacons which, neglected for many centuries, has been resuscitated of late years, and developed according to fixed principles. Where natural landmarks are non-existent, we now-a-days rear small but durable constructions of timber or masonry, at suitable points of the shore, painting them of a brown colour if they stand defined against the sky, as on the summit of a lofty hill, or of a white colour, if they are projected on the land. When it is desirable to indicate the position of a submarine reef, on whose hidden point a good many ships might otherwise go down, a *buoy* is placed there—that is, a floating frame-work of iron or wood, with or without a bell, and painted of various colours. Some of these buoys, as in the channel of a river or the water-way of a harbour, are hollow cones of iron, kept in their positions by stout cables and a heavy anchor. Others, of larger dimensions, resemble a kind of cage; not a few are built up of masonry, where the water

A FLOATING BEACON OR BUOY.

(262)

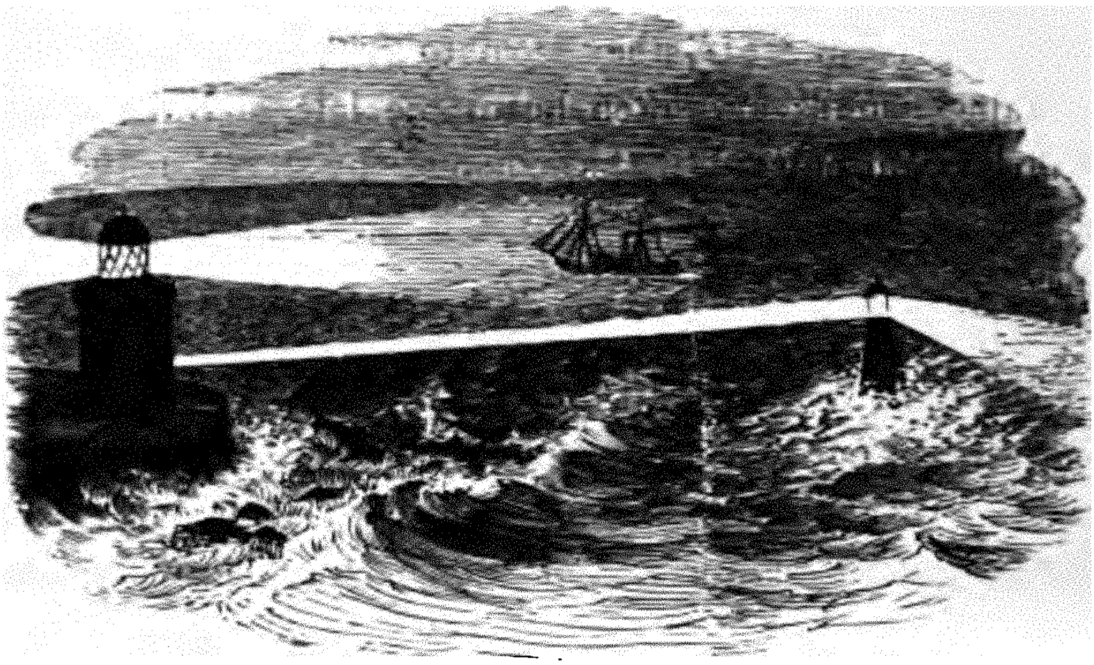
is shallow, like small turrets; and these are provided with chains and ladders for the convenience of shipwrecked seamen. The floating buoys are generally furnished with great bells, which are swung to and fro with a solemn and overpowering peal, by the oscillations of the waves. "Beware! beware!" they seem to cry; but, alas! their warning sounds are often heard too late, and the "tall ship," swept onward by the demon of the storm, frequently dashes against the very buoy that gave warning of the danger.

As a general rule, the buoys in a river channel are painted red, striped with white, if the homeward-bound vessel is to leave them on the right; and black, when she has to pass them on the left. Others are painted with horizontal stripes of red and black, or in squares and diamonds, according to the various purposes they are intended to serve. Obstacles, such as wrecks, are marked by green buoys.

A buoy, recently invented by Mr. Hubert, and adopted by the Trinity Board, is so constructed, with regard to the centre of flotation, and the point where the mooring-chain is attached, that it will keep upright in almost any weather.

Another buoy, invented by Messrs. Brown and Lenox, is ingeniously contrived to render its *bell* audible even when the buoy itself is not visible; the stream of water passing through the lower part of the framework keeps in motion an undershot water-wheel, which incessantly rings the bell.

The average size of the buoys now in use is about eight feet, but many are of larger dimensions; and some, like North-east Spit Buoy, at the east end of Margate Sand, are twenty feet. Various plans for lighting them have been suggested, but with no very successful result. The only felicitous instance is that of the Arnish Beacon



THE ARNISH BEACON.

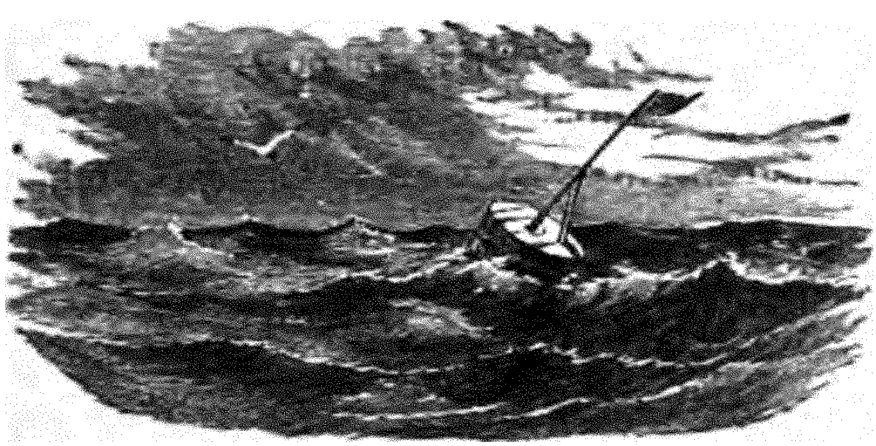
on the north coast of Scotland; it consists of a cone of cast iron plates, surmounted with a lantern containing a glass prism The prism is illuminated by a light directed upon it from Stornaway Lighthouse; and so perfect is the deception that the fishermen long refused to believe there was not a real light on the beacon.

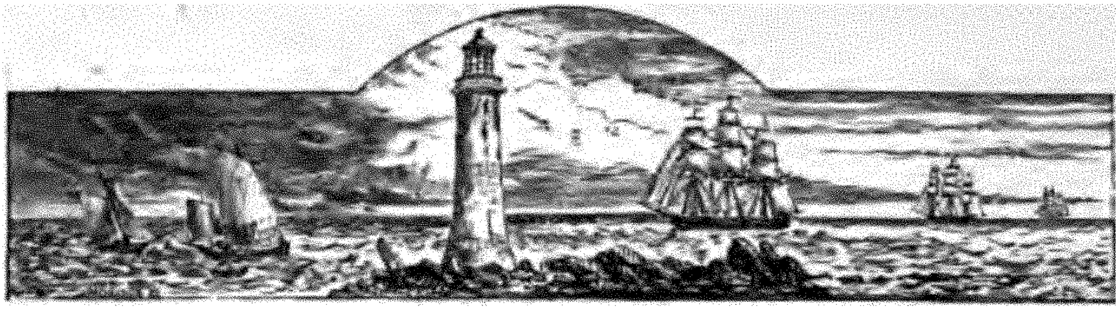
Nearly a thousand buoys are posted about the coast of England and in the channels of her principal rivers. Scotland and Ireland have about two hundred each. These bear their own particular denominations, forming a very diversified and somewhat amusing vocabulary. We find amongst them an "Eagle," a "Gull," a "Swallow," a "Horse," a "Mussel," a "Firefly;" also a "Cutler," a

" Constable," a " Columbine," and a " Fairy ; " a " Royal Sovereign," a " Protector ; " and a " Tongue," an " Elbow," and a " Longnose."

The position of every buoy on the British coast is verified once a quarter ; and every half-year—that is, in March and September—all buoys, except the largest, are "shifted," being replaced by clean ones. After a certain period of immersion they lose their brilliancy of colour, and become encrusted with salt, as well as with organic matter. "Buoy-shifting," says a recent writer, "is a duty which calls forth all the skill and energy of the officers and men comprising the crews of the Trinity House vessels, for the buoys are mostly placed to indicate the position of dangerous shoals, and not unfrequently the change is effected under very inauspicious circumstances. The buoys brought in are carefully examined, and if fit for further use, repainted and repaired."

The cost of a buoy varies, according to its size, from twenty-five to two hundred and fifty pounds.





BOOK VI.

LIFE IN THE LIGHTHOUSE.

CHAPTER I.

THE LIGHTHOUSE-KEEPERS.

THE life of a lighthouse-keeper is not without a certain monotony; but it must be greatly cheered by the reflection that it is devoted to a high and holy service. There is about it a certain heroic simplicity—it is so completely separated from the commonplace aims and concerns of the work-day world; and it is characterized, moreover, by an austere regularity which reminds one of the existence formerly led in grotto and cavern by saint and hermit, though its end is much more useful, and it is in itself of far greater value to mankind.

The first article of the instructions which every lighthouse-keeper is bound to obey—and to obey as implicitly as a soldier obeys the articles of war—runs thus:—

"You are to light the lamps every evening at sun-setting, and keep them constantly burning, bright and clear, till sun-rising."

This is the primary condition of a lighthouse-keeper's duty: for this he lives, for this he toils, for this he watches—that the helpful flame which has been the salvation of so many lives may steadily glow and brightly burn from sunset until sunrise.

"Whatever else happens," remarks a lively writer,* "he is to do this. He may be isolated through the long night-watches, twenty miles from land, fifty or a hundred feet above the level of the sea, with the winds and waves howling round him, and the sea-birds dashing themselves to death against the gleaming lantern, like giant moths against a candle; or it may be a calm, voluptuous, moonlight night, the soft air laden with the perfumes of the Highland heather or the Cornish gorse, tempting him to keep his watch outside the lantern, in the open gallery, instead of in the watch-room chair within; the Channel may be full of stately ships, each guided by his light; or the horizon may be bare of all signs of life, except, remote and far beneath him, the lantern of some fishing-boat at sea: but whatever may be going on outside, there is within for him the duty, simple and easy, by virtue of his moral method and orderly training, 'to light the lamps every evening at sun-setting, and keep them constantly burning, bright and clear, till sun-rising.'"

That this great article of the lighthouse-keeper's faith may be the more easily carried out, he is subjected, both when on probation and afterwards, to a strict discipline, and is required to gain a thorough acquaintance with all

* "Cornhill Magazine," vol. i., pp. 224, 225.

the materials he has to handle—lamps, oil, wicks, lighting apparatus, and revolving machinery. Before being admitted into the service, he is carefully examined as to his physical qualities by keen medical eyes; and as to his moral qualities, the best testimonials are necessary from persons in whose competency and honesty of judgment implicit confidence can be placed. He receives liberal wages, and, when past work, a fair pension; and a deduction from his pay is regularly applied to the discharge of a premium on his life insurance. He is enjoined to "the constant habit of cleanliness and good order in his own person, and to the invariable exercise of temperance and morality in his habits and proceedings; so that, by his example, he may enforce, as far as lies in his power, the observance of the same laudable conduct by his wife and family." The utmost vigilance is expected of him when it is his turn to attend to the lantern. "He whose watch is about to end is to trim the lamps, and leave them burning in perfect order, before he quits the lantern and calls the succeeding watch; and he who has the watch at sunrise, when he has extinguished the lamps, is to commence all necessary preparations for the exhibition of the light at the ensuing sunset." No bed, sofa, or other article on which to recline, is permitted, either in the lantern or in the apartment under the lantern known as the watch-room.

From these requirements we may infer what kind of life is led by the lighthouse-keeper, and what are its leading requisites: temperance, cleanliness, honesty, conscientiousness, zeal, watchfulness. At different stations it varies considerably in its lighter occupations. In the rock lighthouse—such as the Eddystone—the keeper's chief amusements are necessarily reading and fishing: the only capability of exercise is within the circle of the outer gallery, or on the belt of rock surrounding the lighthouse base; and the sole incidents which break up the uniformity of his daily life are the inspections of the committee, the visits of the district superintendent, or the monthly relief which takes the men back to shore. In the shore lighthouse—as at Harwich or the Forelands—there is a plot of ground to cultivate, frequent intercourse with visitors from the neighbouring watering-places, and the wider range of occupation and entertainment which necessarily can be enjoyed upon *terra firma.*

As a rule, the public take but little interest in the economy of our lighthouses; and yet there is something singularly romantic in the idea of the lone tower encircled by boiling waters, with its warning light flashing through the deep night shadows, and the heroic men who hour after hour watch with anxious care lest its radiance should be obscured or extinguished.

"And as the evening darkens, lo! how bright,
Through the deep purple of the twilight air,
Beams forth the sudden radiance of its light
With strange, unearthly splendour in its glare!

"Not one alone: from each projecting cape
And perilous reef along the ocean's verge,
Starts into life a dim, gigantic shape,
Holding its lantern o'er the restless surge.

"Like the great giant Christopher it stands
Upon the brink of the tempestuous wave;
Wading far out among the rocks and sands,
The night-o'ertaken mariner to save.

"And the great ships sail outward and return,
Bending and bowing o'er the billowy swells;
And ever joyful, as they see it burn,
They wave their silent welcomes and farewells.

"They come forth from the darkness, and their sails
Gleam for a moment only in the blaze;
And eager faces, as the light unveils,
Gaze at the tower, and vanish while they gaze.

"The mariner remembers when a child,
On his first voyage, he saw it fade and sink;
And when, returning from adventures wild,
He saw it rise again o'er ocean's brink.

"Steadfast, serene, immovable, the same
Year after year, through all the silent night,
Burns on for evermore that quenchless flame,
Shines on that inextinguishable light!

"'Sail on!' it says, 'sail on, ye stately ships!
And with your floating bridge the ocean span;
Be mine to guard this light from all eclipse,
Be yours to bring man nearer unto man!'" *

As a proof of the romance that formerly invested lighthouse life, we may lay before the reader one or two "true stories."

Off the coast of Northumberland, and outside, so to speak, of the Farne Islands, lies the Longstone—a rock about four feet above high water-mark, and swept by every gale with fierce drifts of spray and foam. Here, about six miles from the shore, is planted a lighthouse, which has been found of great use to the coasting vessels navigating these dangerous waters. Two-and-thirty years ago its keeper was named Darling. He had a daughter, Grace—a quiet, modest, well-behaved girl, whose name, through one noble action, will for ever be honoured among women. On a dark night in September 1838 the *Forfarshire*, a Hull steamer, struck on a hidden reef called the Harcars, in the vicinity of the lighthouse. She had on board sixty-three persons, including passengers and crew. Their signals of distress were observed from the

* Longfellow.

lighthouse. It was impossible for Darling, the keeper, to pull off in his boat alone; no single arm could have impelled it through the raging sea that then prevailed. With admirable courage, Grace Darling resolved to assist him on his noble errand. She sprang into the skiff, and over the bounding billows father and daughter gallantly made their way. Their lives hung upon a thread; but the weak girl never bated a jot of heart or hope, and rowed with all the vigour which a noble enthusiasm is apt to inspire. They reached the ship, and took off nine persons, with whom they contrived to regain the lighthouse. Nine more escaped in one of the steamer's boats: all the rest perished.

Grace Darling did not live many years after the event which made her famous. She was interred in the old chapel on Holy Island, and an epitaph to her memory composed by the poet Wordsworth :—

> "The maiden gentle, yet at duty's call
> Firm and unflinching, as the lighthouse reared
> On the island-rock, her lonely dwelling-place;
> Or like the invisible rock itself, that braves,
> Age after age, the hostile elements,
> As when it guarded holy Cuthbert's cell."

Smeaton speaks of a shoemaker who entered the Eddystone Lighthouse because he longed for a solitary life: he found himself less a prisoner on his wave-beaten rock than in his close and confined workshop. When some of his friends expressed their astonishment at his choice—"Each to his taste," said he; "I have always been partial to independence."

Perhaps it was the same individual who, after having served at the Eddystone upwards of fourteen years, conceived so strong an attachment to his prison that for

is shallow, like small turrets; and these are provided with chains and ladders for the convenience of shipwrecked seamen. The floating buoys are generally furnished with great bells, which are swung to and fro with a solemn and overpowering peal, by the oscillations of the waves. "Beware! beware!" they seem to cry; but, alas! their warning sounds are often heard too late, and the "tall ship," swept onward by the demon of the storm, frequently dashes against the very buoy that gave warning of the danger.

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tion so dangerous that the wounded man had to be lowered into the boat, suspended from a kind of impromptu crane. When he was conveyed ashore he received every attention which his condition demanded ; but he lived only a few days. The jury, acting upon the evidence of his companions, declared that he had committed suicide under an attack of temporary insanity. Perhaps it is not astonishing that persons of a susceptible or excitable temperament should, under the influence of ever-murmuring seas and ever-blowing winds, and while living in a state of almost continual solitude and comparative montony, feel the vertigo of the abyss ascend to their brain, so that the control of reason is loosened, and the mind yields to the first impulse which passes over it.

Let us now take a glance at lighthouse life from a French point of view.

Sagacious regulations and constant inspection have banished the dramatic and the surprising from the French as well as from the English lighthouse. Everything has been reduced to a system, and the keepers are under a discipline scarcely less rigid than that of soldiers. In France, indeed, veteran soldiers or tried seamen are generally selected to fill up any vacancies that may occur in the lighthouse administration. This is divided into two classes : the inspectors, who receive a thousand francs yearly (about £40), and are intrusted with the superintendence of several lighthouses; and the keepers, who are divided into six classes, and whose annual wages vary from 475 to 850 francs (say £18 to £34). Extra payment is awarded to those who serve in the sea lighthouses.

Their number is never less than three in a lighthouse of the first class, or two in those of the second and third class lighthouses.

The "code," so to speak, from which we borrow these details is nearly the same among all maritime nations. It indicates to the keepers their duties, and prescribes to them the nature of their daily work. As for their mode of life, it is much the same everywhere, only more or less agreeable according to the stations. In France the lighthouses served by a single keeper are intrusted to married men, who live in the establishment with their family. Not only does such an arrangement ameliorate their lot, but it also gives the assurance that in case of need they will immediately be replaced in attendance on the lamp—a task so easy that it can be discharged by a woman or even by a child. The habitation allotted to them consists of one or two apartments, with a chimney, an outhouse, and sometimes a cellar. A green and a small garden are invariably attached. In some lighthouses the keeper's house is so placed with reference to the tower that the lamp is visible from one of the windows; but in most the house is annexed to the tower, in such a manner that if the keeper is compelled to rise and attend to the lamp, at least he is not exposed, immediately after leaving his couch, to the rigour, it may be, of a winter night.

In lenticular lights of the first, second, and third class, whose flame requires surveillance throughout the night, several keepers are needed, who take their watch in turn. Formerly the keepers and their families lodged together.

But, unfortunately, those dissensions which seem inevitable when a colony is numerous, and not amenable to a strict discipline, were found to break out at very short intervals, and in an exceedingly disagreeable manner. The authorities, therefore, resolved only to admit their own servants into the interior of the lighthouses, leaving to them, if married, the care of securing suitable lodgings for their wives and children. To each keeper a room was allotted, and the kitchen was common to all.

The result they had in view was thus obtained. But it was soon perceived that to separate the keepers from their families was to impose a heavy tax upon men whose pay was not too liberal; that to deprive them of the sweet domestic joys which are the legitimate reward of the cares and anxieties of paternity, was to increase the gloominess of their isolation, by rendering it more complete; and, finally, to expose them to the strong temptation of absenting themselves from the lighthouse at the hours their presence was most necessary. These inconveniences have been remedied by allotting to each keeper a separate house for himself and his family.

It is, of course, impossible that a keeper's family should be accommodated in a sea lighthouse, which consists of a single tower. They are, therefore, lodged on shore, near the port which keeps up the communication between the lighthouse and the mainland. In such a station life to many minds would be wearisome and monotonous. The wind sometimes blows with so much violence that the keepers can with difficulty breathe. They are then compelled to shut themselves up, as closely as possible, in a tower darkened by the wreathing fog, or by the foam of swelling the materials he has to handle—lamps, oil, wicks, lighting apparatus, and revolving machinery. Before being admitted into the service, he is carefully examined as to his physical qualities by keen medical eyes; and as to his moral qualities, the best testimonials are necessary from persons in whose competency and honesty of judgment implicit confidence can be placed. He receives liberal wages, and, when past work, a fair pension; and a deduction from his pay is regularly applied to the discharge of a premium on his life insurance. He is enjoined to "the constant habit of cleanliness and good order in his own person, and to the invariable exercise of temperance and morality in his habits and proceedings; so that, by his example, he may enforce, as far as lies in his power, the observance of the same laudable conduct by his wife and family." The utmost vigilance is expected of him when it is his turn to attend to the lantern. "He whose watch is about to end is to trim the lamps, and leave them burning in perfect order, before he quits the lantern and calls the succeeding watch; and he who has the watch at sunrise, when he has extinguished the lamps, is to commence all necessary preparations for the exhibition of the light at the ensuing sunset." No bed, sofa, or other article on which to recline, is permitted, either in the lantern or in the apartment under the lantern known as the watch-room.

From these requirements we may infer what kind of life is led by the lighthouse-keeper, and what are its leading requisites: temperance, cleanliness, honesty, conscientiousness, zeal, watchfulness. At different stations it varies considerably in its lighter occupations. In the rock lighthouse—such as the Eddystone—the keeper's chief amusements are necessarily reading and fishing: the only capability of exercise is within the circle of the outer gallery, or on the belt of rock surrounding the lighthouse base; and the sole incidents which break up the uniformity of his daily life are the inspections of the committee, the visits of the district superintendent, or the monthly relief which takes the men back to shore. In the shore lighthouse—as at Harwich or the Forelands—there is a plot of ground to cultivate, frequent intercourse with visitors from the neighbouring watering-places, and the wider range of occupation and entertainment which necessarily can be enjoyed upon *terra firma.*

As a rule, the public take but little interest in the economy of our lighthouses; and yet there is something singularly romantic in the idea of the lone tower encircled by boiling waters, with its warning light flashing through the deep night shadows, and the heroic men who hour after hour watch with anxious care lest its radiance should be obscured or extinguished.

"And as the evening darkens, lo! how bright,
Through the deep purple of the twilight air,
Beams forth the sudden radiance of its light
With strange, unearthly splendour in its glare!

"Not one alone: from each projecting cape
And perilous reef along the ocean's verge,
Starts into life a dim, gigantic shape,
Holding its lantern o'er the restless surge.

"Like the great giant Christopher it stands
Upon the brink of the tempestuous wave;
Wading far out among the rocks and sands,
The night-o'ertaken mariner to save.

"And the great ships sail outward and return,
Bending and bowing o'er the billowy swells;
And ever joyful, as they see it burn,
They wave their silent welcomes and farewells.

13. **Plymouth,** West Barbican Pier-head, lat. 50° 22′; one fixed light (*gas*), visible 6 miles; 20 feet high; erected 1822.
14. **Start Point,** lat. 50° 13′; two lights, revolving every minute, visible 20 miles; 92 feet high; erected 1836.
15. **Dartmouth,** Kingswear, lat. 50° 20′; one fixed light, visible 11 miles; 36 feet high; erected 1864.
16. **Dartmouth;** a flagstaff, carrying one fixed light.
17. **Dartmouth,** south part of town; one white light.
18. **Brixham,** pier-head; lat. 50° 24; one fixed light, visible 6 miles; erected 1839.
19. **Torquay,** pier-head; lat. 50° 27′; one fixed light, visible 5 miles; erected 1852.
20. **Teignmouth,** south-west end of Dam; lat. 50° 32′; two fixed lights, visible 6 miles; 37 feet high; erected 1845.
21. **Lyme Regis,** pier-head and Custom House, lat. 50° 43′; a bright and a red fixed light, each visible 4 miles; erected 1853.
22. **Portland,** near the Bill, lat. 50° 31′; two fixed lights, visible 21 and 18 miles; 50 and 85 feet high; erected 1789 and 1867.
23. **Portland,** breakwater, fixed light, visible 9 miles; erected 1851.
24. ‡ **Portland,** Shambles Shoal Lightship; one fixed light, visible 10 miles; fixed 1859.
25. **Weymouth,** North Pier; two fixed green and two fixed red lights; erected 1867.
26. **Casquets,** lat. 49° 43′ 17″; three lights, revolving every 20 seconds, and visible for 15 miles; one light 45 feet and the others 68 feet high; erected 1723.
27. **Alderney Island,** lat. 49° 43′; two fixed red lights (*gas*), visible 5 to 9 miles; 55 and 25 feet high; erected 1859.
28. **Guernsey,** St. Peter Port Old Harbour; one fixed light (*gas*), visible 3 miles; 24 feet high; erected 1832.
29. **Guernsey,** St. Peter Port New Harbour, lat. 49° 27′; one fixed light (*gas*), visible 9 miles; 40 feet high; erected 1867.
30. **Guernsey,** Rock of Stanois, lat. 49° 26′; one red light, revolving every 45 seconds; 117 feet high; erected 1862.
31. **Jersey,** Vernclût Breakwater, lat. 49° 13′; one fixed light, visible 10 to 12 miles; 30 feet high; erected 1857.
32. **Jersey,** Gouray Pier-head, one fixed light, *gas*.
33. **Jersey,** Victoria Pier, St. Helier, lat. 49° 10′; one fixed light, visible 6 miles; erected 1858.
34. **Jersey,** Albert Pier, St. Helier; one fixed light (*gas*), visible 3 miles; erected 1839.
35. **Jersey,** Albert Pier, St. Helier; two fixed lights, *gas;* erected 1837.
36. **Jersey,** Upper Pier Road, St. Helier, one fixed red light (*gas*), visible 3 miles; erected 1859.
37. **Corbière Rocks,** lat. 49° 10′ 40″. New lighthouse building.
38. ‡ **Minquiers** Lightship, lat. 48° 53′ 38″; two fixed lights, visible 8 or 10 miles; fixed 1865.
39. **Poole,** north side of harbour, lat. 50° 41′; two fixed lights, visible 6 miles; erected 1848.
40. **Poole,** North Haven Point; one fixed light.
41. **Isle of Wight,** Needle Rock, lat. 50° 39′ 42″; one fixed light, visible 14 miles; 109 feet high; erected 1859.
42. **Hampshire,** Hurst Point, lat. 50° 42′ 26″: two fixed lights, visible 13 and 10 miles; one, 85 feet high, erected 1812; the other, 52 feet high, erected 1733.

43. **Isle of Wight,** Yarmouth; two fixed lights, green and white, erected 1857
44. ‡**Isle of Wight,** Calshot Lightship; one light, revolving every minute, visible 9 miles; fixed 1842.
45. **Hampshire,** Southampton, Royal Pier; two fixed lights; erected 1841.
46. **Isle of Wight,** Ryde Pier; one fixed light, visible 6 or 7 miles; erected 1852.
47. **Hampshire,** Stokes Bay Pier; two fixed lights; erected 1865.
48. **Hampshire,** Southsea Castle, lat. 50° 47′; one fixed light, visible 9 miles; erected 1822.
49. **Hampshire,** Spit Sand Fort; one fixed light; erected 1866.
50. **Hampshire,** Horse Sand Fort; one fixed light; erected 1866 (temporary).
51. **Hampshire,** Noman's Land Fort; one fixed red light; erected 1866.
52. **Isle of Wight,** Brading Haven Fort; one fixed green light; erected 1866.
53. **Portsmouth,** Clarence Pier; three lights, *gas;* erected 1865.
54. **Portsmouth,** Victoria Pier; two lights, *gas;* erected 1865.
55. **Portsmouth,** Camber; one fixed light.
56. **Portsmouth,** King's Stairs; one fixed red light; erected 1865.
57. **Portsmouth,** Clarence Victualling Yard, pier; one red light, *gas;* erected 1865.
58. **Gosport,** one fixed red light; erected 1865.
59. ‡**Warner** Lightship, lat. 50° 43′; revolving every minute, visible 8 miles; fixed 1854.
60. **Temporary,** to indicate a wreck, 1½ miles S.E. of the Warner.
61. ‡**Nab** Lightship, lat. 50° 42′ 15″; two fixed lights, visible 8 and 6 miles; fixed 1812.
62. **Isle of Wight,** St. Catherine's Point, lat. 50° 34′ 30″; one fixed light, visible 19 miles; 122 feet high; erected 1840.
63. ‡**Owers** Lightship, lat. 50° 38′ 50″; one fixed light, visible 10 miles; fixed 1788.
64. **Littlehampton,** north end of pier, lat. 50° 48′; one fixed light (*gas*), visible 7 miles; 40 feet high; erected 1848.
65. **Littlehampton,** Outer East Pier; one fixed light; erected 1868.
66. **Worthing Pier,** lat. 50° 48′ 30″; one fixed light; erected 1862.
67. **Shoreham Harbour,** lat. 50° 50′; two fixed lights, visible 10 miles; 38 and 5 feet high; erected 1825.
68. **Brighton,** Chain Pier, lat. 50° 49′; one fixed green light, visible 10 miles; 22 feet high; erected 1824.
69. **Newhaven,** West Pier, lat. 50° 47′; two fixed lights, visible 10 miles; 33 feet high; erected 1864.
70. **Newhaven,** East Pier, one fixed green light; erected 1862.
71. **Beachy Head,** Belle Tout Cliff, lat. 50° 44′ 15″; revolving light every 2 minutes, visible 23 miles; 47 feet high; erected 1828.
72. **Eastbourne,** lat. 50° 45′; a single lamp.
73. **Hastings,** lat. 50° 52′; upper light on west hill, visible 12 miles; lower, on beach, visible 5 miles; both *gas.*
74. **Rye,** Camber, lat. 50° 57′; two fixed lights, *gas.*
75. **Rye,** the pier-head; two fixed lights; erected 1860.
76. **Rye,** the Groin; one fixed light, *gas;* erected 1864.
77. **Dungeness Point,** lat. 50° 54′ 57″; one fixed light (*electric*), visible 15 miles; 107 feet high; erected 1792.

78. ‡ **Varne Shoal** Lightship, lat. 50° 56′; revolving light every 20 seconds, visible 10 miles; fixed 1860.
79. **Folkestone,** South Pier head, lat. 51° 4′; two fixed lights, visible 6 miles; 31 feet high; erected 1848.
80. **Folkestone,** New Pier; one fixed green light, visible 6 miles; 28 feet high; erected 1860.
81. **Dover,** Admiralty Pier; one fixed blue light; erected 1849.
82. **Dover,** South Pier, lat. 51° 7′; three fixed red lights (*gas*), visible 12 miles; erected 1852.
83. **Dover,** North Pier; one fixed red light; erected 1842.
84. **Dover,** near Clock Tower; one fixed green light; erected 1852.
85. **South Foreland,** lat. 51° 8′ 23″; two fixed lights, visible 26 and 23 miles; one light, 69 feet high, the other, 49 feet; erected 1793.
86. **Deal,** Iron Pier, one fixed red light; erected 1865.
87. ‡ **Goodwin Sand,** South Sand Head Lightship, lat. 51° 9′ 35″; one fixed light, visible 10 miles; fixed 1832.
88. ‡ **Goodwin Sand,** Gull Stream Lightship, lat. 51° 16′; revolving light every 20 seconds, visible 7 miles; fixed 1809.
89. ‡ **Goodwin Sand,** North Sand Head Lightship, lat. 51° 19′ 23″; three fixed lights, visible 10 miles; fixed 1793.

SOUTH-EAST COAST.

90. **Ramsgate,** West Pier-head, lat. 51° 19′ 42″; one fixed light, visible 7 miles; 37 feet high.
91. **Ramsgate,** East Pier-head; one light, flashing every 5 seconds, and dark 5 seconds; erected 1867.

Thames River and Mouth; Kent and Essex Banks— Nos. 92 to 115.

[92. **North Foreland,** lat. 51° 22′ 28″; one fixed light, visible 19 miles; 85 feet high; erected 1790.
93. **Margate,** West Pier, lat. 51° 24′; one fixed light, visible 10 miles; stone column, 70 feet high; erected 1829.
94. ‡ **East Tongue Sand** Lightship, lat. 51° 29′; two fixed lights, visible 10 and 4 miles; fixed 1848.
95. ‡ **Princes Channel** Lightship, one revolving light every 20 seconds, visible 10 miles; fixed 1836.
96. ‡ **West Goodwin Sand** Lightship, lat. 51° 29′; one revolving light every 30 seconds, visible 10 miles; fixed 1848.
97. ‡ **Nore** Lightship, lat. 51° 29′; one revolving light every 30 seconds, visible 10 miles; fixed 1732.
98. **Sheerness,** left demi-bastion, lat. 51° 26′ 48″; one fixed light, *gas*; erected 1859.
99. **Sea Reach,** Southend Pier-head; one red light; erected 1840.
100. §**Sea Reach,** Chapman Head; one fixed light, visible 11 miles; 74 feet high; erected 1849.
101. §**Sea Reach,** Mucking Flat; one fixed light, visible 11 miles; 71 feet high; erected 1849.
102. **Hope Point,** fort; one fixed light, for colliers only; erected 1852.
103. **Northfleet,** wharf; fixed light on iron frame; erected 1859.

EAST COAST.

104. ‡ **Mouse** Lightship, lat. 51° 32′; revolving light every 20 seconds, visible 10 miles; fixed 1838.
105. § **Maplin Sands**, lat. 51° 35′; one fixed light, visible 10 miles; 69 feet high; erected 1838.
106. ‡ **Middle Swin**, Lightship, lat. 51° 39′; revolving light every minute, visible 10 miles; fixed 1837.
107. § **Gunfleet Sand**, lat. 51° 45′ 50″; one revolving light every 30 seconds, visible 10 miles; 72 feet high; erected 1850.
108. ‡ **Sunk** Lightship, lat. 51° 49′ 28″; one fixed light, visible 10 miles; fixed 1802.
109. ‡ **Kentish Knock** Lightship, lat. 51° 40′ 50″; one revolving light every minute, visible 10 miles; fixed 1840.
110. ‡ **Galloper** Lightship, lat. 51° 45′; two fixed lights, visible 10 miles; fixed 1803.
111*a*. § **Harwich**, Dovercourt; two fixed lights, visible 12 and 9 miles; 45 and 27 feet high; erected 1863.
111*b*. **Harwich**, North Jetty; one fixed light; erected 1869.
112. **Harwich**, near Landguard Point, lat. 51° 56′ 15″; one fixed light, visible 5 miles; 38 feet high; erected 1868.
113. ‡ **Cork** Lightship, lat. 51° 46′; one revolving light every 30 seconds, visible 10 miles; fixed 1844.
114. ‡ **Shipwash** Lightship, lat. 52° 1′ 30″; one fixed red light, visible 10 miles; fixed 1837.
115. **Orfordness**, lat. 52° 5′; two fixed lights, visible 17 and 14 miles; the high lighthouse 79 feet, the low lighthouse 72 feet; both erected 1792. The high lighthouse is a circular, and the lower a sixteen-sided edifice]

116. **Kessingland**, cliff, lat. 52° 24′ 50″; one fixed light; 68 feet high; erected 1867.
117. **Lowestoft**, Harbour Pier; two fixed lights; erected 1847.
118. **Lowestoft**, cliff, lat. 52° 29′ 14″; two fixed lights, visible 16 and 11 miles; the cliff lighthouse, 53 feet high, erected 1609; the low lighthouse, on the Ness, 48 feet; erected 1866.
119. **Corton Gatway**; two fixed lights, one 52 feet, the other 18 feet high; erected 1865.
120. ‡ **Corton** Lightship, lat. 52° 31′ 15″; revolving light every 20 seconds, visible 10 miles; fixed 1862.
121. ‡ **Hewett Channel**, or St. Nicholas Gate Lightship; two fixed lights, visible 10 and 4 miles; fixed 1837.
122. **Yarmouth**, South Pier, lat. 52° 34′ 25″; one fixed light; erected 1852.
123. ‡ **Cocker** Lightship, lat. 52° 41′; revolving light every minute, visible 10 miles; fixed 1844.
124. **Winterton**, lat. 52° 43′; one fixed light, visible 14 miles; 69 feet high: erected 1790. [The old lighthouse is mentioned in "Robinson Crusoe."]
125. ‡ **Newarp** Lightship, lat. 52° 45′; three fixed lights, visible 10 miles; fixed 1791.
126. **Hasborough**, lat. 52° 49′; two fixed lights, visible 17 and 15 miles: 95 feet high; erected 1791.

127. ‡ **Hasborough** Lightship, lat. 52° 58′; two fixed lights, visible 10 miles; fixed 1832.
128. ‡ **Leman and Ower** Lightship, lat. 53° 8′ 45″; two lights, one revolving every minute and one fixed, visible 10 miles; fixed 1840.
129. **Cromer**, cliff, lat. 52° 56′; one revolving light, visible 23 miles; 59 feet high; erected 1719.
130. **Hunstanton Point**, lat. 52° 56′ 54″; one fixed light, visible 16 miles; 63 feet high; erected 1665.
131. ‡ **Lynn Well** Lightship, lat. 53° 1′ 25″; one revolving light, every 20 seconds, visible 10 miles; fixed 1828.
132. **Lynn**; two fixed lights; erected 1868.
133. **Boston**, Hob Hole; two fixed lights; erected 1868.
134. ‡ **Dudgeon** Lightship, lat. 53° 15′; one fixed light, visible 10 miles; fixed 1736.
135. ‡ **Outer Dowsing** Lightship, lat. 53° 28′ 15″; one revolving light every 20 seconds, visible 10 miles; fixed 1861.

HUMBER RIVER—Nos. 136 to 150.

[136. ‡ **Spurn** Lightship, lat. 53° 34′; one light revolving every minute, visible 10 miles; fixed 1820.
137. **Spurn Point**, lat. 53° 34′ 44″; two lighthouses, with fixed lights; one, visible 15 miles, 112 feet high; the other, visible 12 miles, 76 feet high; erected 1776.
138. ‡ **Bull Sand** Lightship, lat. 53° 34′; one fixed light, visible 8 miles; fixed 1851.
139. **Grimsby**, pier-head; two fixed red lights.
140. **Stallingborough**, ferry, lat. 53° 37′; one fixed light; erected 1849.
141. **Killingholm**, lat. 53° 39; three fixed lights, visible 11 miles; high lighthouse, 77 feet high, erected 1831; north tower, 45 feet high, erected 1836; south-east tower, 45 feet high, erected 1852.
142. **Paull**, lat. 53° 43′; one fixed light, visible 7 miles; 30 feet high; erected 1836.
143. ‡ **Hebbles** Lightship, lat. 53° 44′; one fixed light, visible 5 miles; fixed 1839.
144. **Chaldersness**; one fixed light; erected 1863.
145. **Winteringham**; two fixed lights; erected 1862.
146. **Brough**; two fixed lights.
147. ‡ **Whitton** Lightship; two fixed lights; fixed 1865.
148. **Whitton**, New Pier; two fixed lights; erected 1862.
149. **Walker**; one fixed blue light; erected 1863.
150. **Faxfleetness**; one fixed light; erected 1863.]

151. **Bridlington**, North Pier-head, lat. 54° 5′ 12″; one fixed light; erected 1852.
152. **Flamborough Head**, lat. 54° 7′; revolving light every two minutes, visible 21 miles; 87 feet high; erected 1806.
153. **Scarborough**, Vincent Pier, lat. 54° 17′; one fixed light, visible 13 miles; 56 feet high; erected 1806.
154. **Whitby**, West Pier-head, lat. 54° 30′; one fixed light, visible 10 miles; 60 feet high; erected 1831.
155. **Whitby**, East Pier-head; one fixed light, visible 8 miles; erected 1855.
156. **High Whitby**, lat. 54° 28′ 40″; two fixed lights, visible 23 miles; south lighthouse, 66 feet high; north tower, 46 feet high.

RIVER TEES—NOS. 157 to 160.

[157. **Brand Sand,** lat. 54° 38′; two lighthouses, 60 and 45 feet high; erected 1839. Not used.

158. **Fifth Buoy,** lat. 54° 37′ 36″; one fixed light on piles; erected 1866.

159. **Seal Sand,** one fixed red light.

160. **Seaton,** lat. 54° 50′; high lighthouse, ½ mile inland, 70 feet high, erected 1839; low lighthouse, on shore, fixed lights, visible 13 miles.]

161. **Hartlepool,** North Pier-head; one fixed green light; erected 1855.

162. **Hartlepool,** Pier-head, lat. 54° 51′; one fixed light, visible 7 miles; erected 1836.

163. **Hartlepool,** Heugh, lat. 54° 41′ 51″; two fixed lights, visible 15 and 4 miles; 73 feet high; erected 1847.

164. **Seaham,** South Pier-head, lat. 54° 50′; one fixed light, visible 4 miles; erected 1846.

165. **Seaham,** Red Acre Point; two lights—high one fixed, visible 14 miles; low one, revolving every 30 seconds, visible 11 miles; 58 feet high; erected 1857.

166. **Sunderland,** North and South Pier-heads, lat. 54° 55′; three fixed lights, visible 13, 10, and 6 miles; north tower, 64 feet; south tower, 23 feet; erected 1802.

167*a*. **Souter Point,** lat. 54° 58′ 10″; one fixed and flashing light (*electric*) every minute; 75 feet high; erected 1870.

167*b*. **Tynemouth,** Castle Yard, lat. 52° 1′; revolving light every minute, visible 18 miles; 79 feet high; erected 1802. To be discontinued when Souter Point Lighthouse is completed.

168. **Tynemouth,** North Pier Works; three fixed lights; erected 1864.

169. **Tynemouth,** North Pier; erected 1865. To be moved out as the works advance.

170. **Tyne, or North Shields,** lat. 55° 0′ 30″; two fixed lights, visible 16 and 13 miles; 49 and 76 feet high; erected 1808.

171. **Blyth,** lat. 55° 7′; two fixed lights, visible 11 and 7 miles; 41 and 35 feet high; erected 1788.

172. **Coquet Island,** lat. 55° 20′; two fixed lights, visible 14 miles; square white tower, 72 feet high; erected 1841.

173. **Warkworth,** South Pier, lat. 55° 21′; one fixed red light; erected 1848.

174. **Farne Island,** lat. 55° 37′. High lighthouse—revolving light every 30 seconds, visible 15 miles; white tower, 43 feet high; erected 1766. Low lighthouse—fixed light, visible 12 miles; 27 feet high (octagonal tower); erected 1810.

175. **Longstone Rock,** lat. 55° 39′; one light, revolving every 30 seconds, visible 14 miles; 85 feet high; erected 1826.

176. **Berwick Pier-head,** lat. 55° 46′; two fixed lights, visible 12 and 8 miles; 44 feet high.

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SCOTLAND.

EAST COAST.

177. **Eyemouth,** lat. 55° 52′; two fixed lights, visible 10 and 8 miles; erected 1857.

178. **St. Abb's Head,** lat. 55° 55′; flashing light, every 10 seconds, visible 20 miles; 29 feet high; erected 1862.

179. **Dunbar,** Old Harbour, lat. 56°; one fixed light (*gas*), visible 5 miles; 27 feet high; erected 1857.
180. **Dunbar,** Victoria Harbour; one fixed light, *gas*.

FIRTH OF FORTH—Nos. 181 to 207.

[181. **Cockenzie,** pier-head; one fixed green light, visible 8 miles.
182. **Fisherrow,** pier-head, lat. 55° 56′; fixed light; erected 1839.
183. **Leith,** East Pier, inner part, lat. 55° 59′; one fixed light, visible 8 miles; 19 feet high; erected 1758.
184. **Leith,** East Pier-head; one fixed green light; visible 8 miles.
185. **Leith,** West Pier; one fixed light, visible 10 miles; 19 feet high; erected 1829.
186. **Newhaven,** pier-head, lat. 55° 59′; one fixed light, visible 5 miles; 29 feet high.
187. **Granton,** pier-head; one fixed light, visible 6 miles; 40 feet high; erected 1845.
188. **Granton,** breakwater; two fixed red lights; 12 feet high.
189. **Inchkeith Island,** lat. 56° 2′; one light, revolving every minute, visible 20 miles; stone lighthouse, 58 feet high; erected 1804.
190. **Grangemouth;** one fixed light, visible 10 miles; stone tower, 30 feet high; erected 1847.
191. **Charleston,** outer pier; one fixed light; erected 1866.
192. **Inverkeithing,** West Quay, two fixed red lights; erected 1856.
193. **St. David;** one fixed light; erected 1866.
194. **Burntisland,** East Pier-head, lat. 56° 4′; one fixed light, visible 8 miles; 25 feet high; erected 1860.
195. **Burntisland,** Ferry Pier; one fixed light; 9 feet high.
196. **Burntisland,** New Pier; one fixed light; erected 1867.
197. **Pettycur,** pier; one fixed light; erected 1854.
198. **Kirkcaldy,** East Pier-head, lat. 56° 7′; one fixed light (*gas*), visible 8 miles.
199. **Dysart**; one fixed green light, *gas*.
200. **West Wemyss,** pier-head; one fixed red light.
201. **Buckhaven,** East Pier-head, lat. 56° 10′ 6″; one fixed light; iron tower, 9 feet high; erected 1854.
202. **St. Monans,** lat. 56° 12′ 30″; two fixed lights, visible 6 miles.
203. **Pittenweem,** East Pier-head, lat. 56° 13′; one fixed light, visible 6 miles; erected 1853.
204. **Pittenweem,** saw-mill, one fixed light, visible 6 miles; erected 1853.
205. **East Anstruther,** West Pier-head, lat. 56° 13′ 16″; two fixed lights (*gas*), visible 4 miles; erected 1848.
206. **Cellardyke,** lat. 56° 14′; one fixed red light, *gas*.
207. **Isle of May,** lat. 56° 11′ 9″. Lighthouse on summit of island—one fixed light, visible 21 miles; 78 feet high; erected 1816. Lighthouse on north-east side—one fixed light, visible 15 miles; 36 feet high; erected 1844.]

208. **Bell Rock,** lat. 56° 26 3′; one light, revolving every two minutes, visible 15 miles; 117 feet high; erected 1811.
209. **St. Andrews,** pier-head, lat. 56° 20′ 3″; one fixed red light, visible 6 miles; 18 feet high; erected 1825.
210. **St. Andrews,** Cathedral turret; one fixed light, visible 5 miles; erected 1849.

FIRTH OF TAY—NOS. 211 to 215.

[211. **Buddonness,** lat. 56° 28′; two fixed lights, visible 15 and 12 miles; one on tower, 104 feet high, erected 1820; the lower one, 65 feet high.

212. **Port-on-Craig,** lat. 56° 27′; two fixed lights, visible 12 and 10 miles; one on tower, 76 feet high; one on piles, 53 feet high; erected 1820 and 1845.

213. **Newport,** West Ferry Pier, lat. 56° 26′; two fixed lights, visible 8 and 7 miles.

214. **Dundee Harbour,** Middle and East Piers, lat. 56° 28′; two fixed lights, visible 8 and 7 miles.

215. **Dundee,** Camperdown Docks; two fixed red lights, *gas;* erected 1865.]

216. **Arbroath,** Outer Harbour, lat. 56° 33′; one fixed light, visible 8 miles; stone tower, 22 feet high; erected 1826.

217. **Arbroath,** Inner Harbour; two fixed lights.

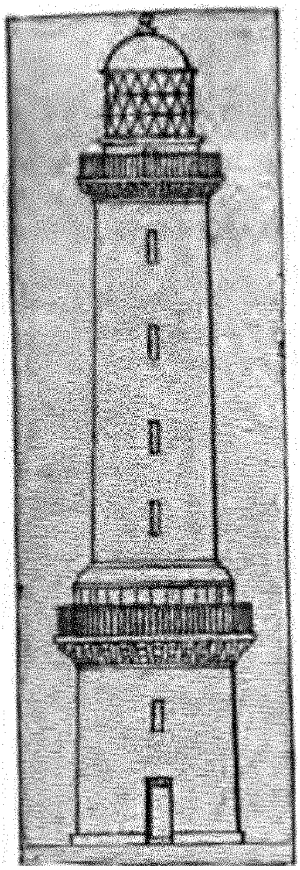
218. **Ness,** Scurdyness, lat. 56° 42′; one fixed light; erected 1870.*

219. **Montrose,** north side of harbour; two fixed lights, visible 11 and 10 miles; 65 and 39 feet high; erected 1818.

220. **Stonehaven,** harbour, lat. 56° 58′; two fixed lights, visible 8 miles; erected 1839.

* We condense the following report from the *Dundee Advertiser,* March 1, 1870:—

"On Tuesday night the Scurdyness Lighthouse, at the entrance to Montrose Harbour, was lit up for the first time, amid the rejoicings of the people of Montrose and Ferryden. From early morning the vessels in the harbour displayed numerous flags, and more than the usual stir was observable among the villagers on the opposite side of the river. Indeed, seldom have the Ferryden people manifested so much enthusiasm; but it is seldom that they have so much cause to rejoice. The want of a light at the Scurdyness has long been felt by the seafaring community. The rock-bound shore stretching between the Bell Rock and the Girdleness—a distance of nearly fifty miles—is perhaps one of the most dangerous parts of the east coast of Scotland, and has been the scene of numerous shipwrecks and great loss of life. At no point within these limits have so many disasters occurred as at the entrance to Montrose Harbour, now fortunately protected by the Scurdyness Light. Bounded on the one side by large outlying and in some instances hidden rocks, and on the other by a long stretch of sandy shore, whilst the channel itself is extremely narrow, the entrance to Montrose Harbour is very difficult for navigation, and particularly so when the weather is boisterous. Moreover, on the north side, and within a very short distance of the newly-erected lighthouse, is the Annat—a sandbank on which many vessels have been wrecked in attempting to make the harbour. The necessity, therefore, for a light on Scurdyness was very great, and has been long and deeply felt. Situated at the Point, on the southern side of the channel, the lighthouse, a substantial building, commands a clear-weather range of seventeen nautical miles. It is built on solid rock, the foundation being of stones from Benholm Quarry, and the tower itself of white brick. The entire height of the tower is about 100 feet and the lighthouse about 30 feet—in all, 130 feet from base to vane. The diameter at the base is 23 feet 2 inches, whilst at the top it is 16 feet. A spiral stair of about 140 steps leads to the top of the tower, after which the ascent



GIRDLENESS LIGHT-HOUSE.

221. **Girdleness**, lat. 57° 8′ 15″; two lights, visible 19 and 16 miles; stone lighthouse, 120 feet high; erected 1833.
222. **Aberdeen**, North Pier-head, lat. 57° 8′ 20″; one fixed light, visible 8 miles; white tower, 29 feet high; erected 1866.
223. **Aberdeen**, ferry; two fixed lights, 8 miles; erected 1842.
224. **Buchanness**, lat. 57° 28′ 15″; one light, flashing every 5 seconds, visible 16 miles; 115 feet high; erected 1827.
225. **Peterhead**, South Harbour, lat. 57° 30′; one fixed light, visible 10 miles; 26 feet high; erected 1834.
226. **Peterhead**, North Harbour: one fixed light, visible 10 miles; 32 feet high; erected 1849.
227. **Fraserburgh**, Pier-head and Middle Pier, lat. 57° 41′ 30″; two fixed red lights, visible 5 miles; erected 1841.
228. **Kinnaird Head**, lat. 57° 41′ 51″; one fixed light, visible 15 miles; 76 feet high; erected 1787.
229. **Macduff**, North Pier-head, lat. 57° 40′; one fixed light, visible 6 miles.
230. **Banff**, North Pier-head, lat. 57° 40′; one fixed light, visible 8 miles, erected 1832.
231. **Banff**, New Harbour, lat. 57° 40′ 5″; two fixed lights; erected 1851.
232. **Elgin and Lossiemouth**, South Pier-head; one fixed green light; erected 1838.
233. **Covesea Skerries**, Craig Head, lat. 57° 43′ 15″; one light, revolving every minute, visible 18 miles; stone lighthouse 18 feet high; erected 1846.
234. **Chanonry**, Point, lat. 57° 34′ 30″; one fixed light, visible 11 miles; stone lighthouse, 42 feet high; erected 1846.
235. **Cromarty**, lat. 57° 41′; one fixed light, visible 9 miles; 42 feet high; erected 1846.
236. **Tarbet Ness**, lat. 57° 51′ 54″; one intermittent light, visible 2½ minutes, dark ½ minute; visible 15 to 18 miles; tower, 134 feet high; erected 1830.
237. **Little Ferry**, lat. 57° 56′; two fixed lights.
238. **Latheronwheel**, South Head, lat. 58° 16′ 10″; one fixed light; erected 1852.

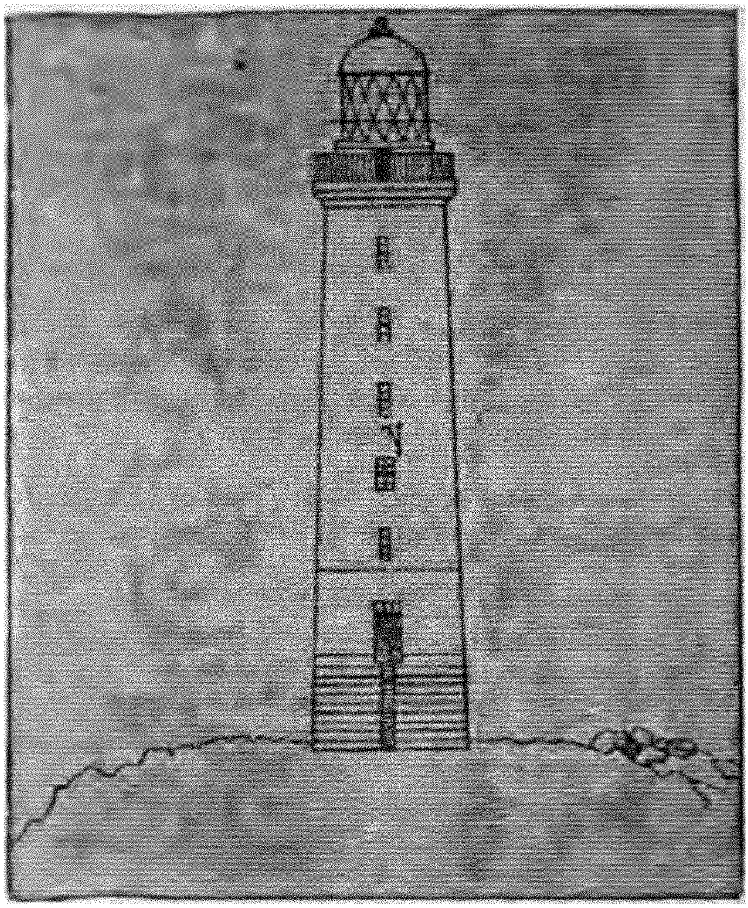
to the various stories is by ladders. There is a room near the top, in which are deposited the stores. The light is fixed and white, of the second order (dioptric), and the mechanism for supplying the lamp with oil is of the most interesting nature. Oil is pumped up to the wick by clock-work; and an alarm sounds during the whole time the machine is in motion, so that any irregularity is immediately announced to the attendant. The light will be seen from about S W. ½ S., round by the east to about N.E. ½ N., or as far as the land will permit. The bearings are magnetic, and from the vessel. A light of weaker power will be shown from the channel towards Montrose Har-

239. **Wick,** North Pier-head, lat. 58° 26′; two fixed lights (*gas*), visible 8 miles; 34 feet high; erected 1851.
240. **Noss Head,** lat. 58° 28′ 38″; one light, revolving every half minute, visible 18 miles; 68 feet high; erected 1849.
241. **Pentland Skerries,** island, 58° 41′ 22″; two fixed lights, visible 18 and 16 miles; high light, 118 feet high; low light, 88 feet high; 33 yards distant; erected 1794.
242. **Dunnet Head,** lat. 58° 40′ 16″; one fixed light, visible 23 miles; 66 feet high; erected 1831.
243. **Holburn,** Little Head, Thurso Bay, lat. 58° 36′ 50″; one light, flashing every 10 seconds, visible 13 miles; 55 feet high; erected 1862.
244. **Orkney Isles,** Cantick Head, Hoy Isle, lat. 58° 47′; one light, revolving every minute, visible 15 miles; brick lighthouse, 73 feet high; erected 1858.
245. **Orkney Isles,** Hoy Sound, lat. 58° 56′ 9″; two fixed lights, visible 15 and 11 miles; high light, Gremsa Isle, north-east point, 108 feet high, erected 1851; low light, Gremsa Isle, north-west point, 38 feet high.
246. **Orkney Isles,** Kirkwall, lat. 58° 59′ 10″; one fixed light, visible 9 miles; 27 feet high; erected 1854.
247. **Orkney Isles,** Auskerry, Stronsa Firth, lat. 59° 2′; one fixed light, visible 16 miles; brick lighthouse, 112 feet high; erected 1867.
248. **Orkney Isles,** Start Point, Sanday Isle, lat. 59° 16′ 39″; one fixed light, visible 15 miles; 91 feet high; erected 1806.
249. **Orkney Isles,** North Ronaldsha, lat. 59° 23′ 15″; one light, flashing every 10 seconds, visible 17 miles; brick lighthouse, 139 feet high; erected 1854.
250. **Shetland Isles,** Sumburgh Head, lat. 59° 51′; one fixed light, visible 22 miles; stone lighthouse, 55 feet high; erected 1821.
251. **Shetland Isles,** Bressay, lat. 60° 6′ 10″; one light, revolving every minute, visible 17 miles; brick lighthouse, 98 feet high; erected 1854.
252. **Shetland Isles,** Whalsey Skerries, lat. 60° 25′ 24″; one light, revolving every minute, visible 17 miles; brick tower, 98 feet high; erected 1854.
253. **Shetland Isles,** North Unst, lat. 60° 51′ 20″; one fixed light, visible 21 miles; 64 feet high; erected 1854.
254. **Cape Wrath,** north-west point of Scotland, lat. 58° 37′ 30″; one light, revolving every two minutes, visible 30 miles; tower, 65 feet high; erected 1828.
255. **Ru Stoer,** lat. 58° 14′ 10″. Now building.

NORTH COAST.

256. **South Rona Island,** lat. 57° 34′ 31″; one light, flashing every 12 seconds, visible 20 miles; tower, 42 feet high; erected 1857.
257. **Kyle Akin,** Gilliean Island, lat. 57° 16′ 39″; one fixed light, visible 11 miles; 70 feet high; erected 1857.
258. **Oronsay Island,** lat. 57° 8′ 39″; one fixed light, visible 12 miles; 63 feet high; erected 1857.
259. **Hebrides,** Butt of Lewis, north point, lat. 58° 30′ 40″; one fixed light, visible 18 miles; lighthouse tower, 120 feet high; erected 1862.
260. **Hebrides,** Stornoway, Arnish Point,* lat. 58° 11′ 28″; one light, revolving every 30 seconds, visible 12 miles; 45 feet high; erected 1852.

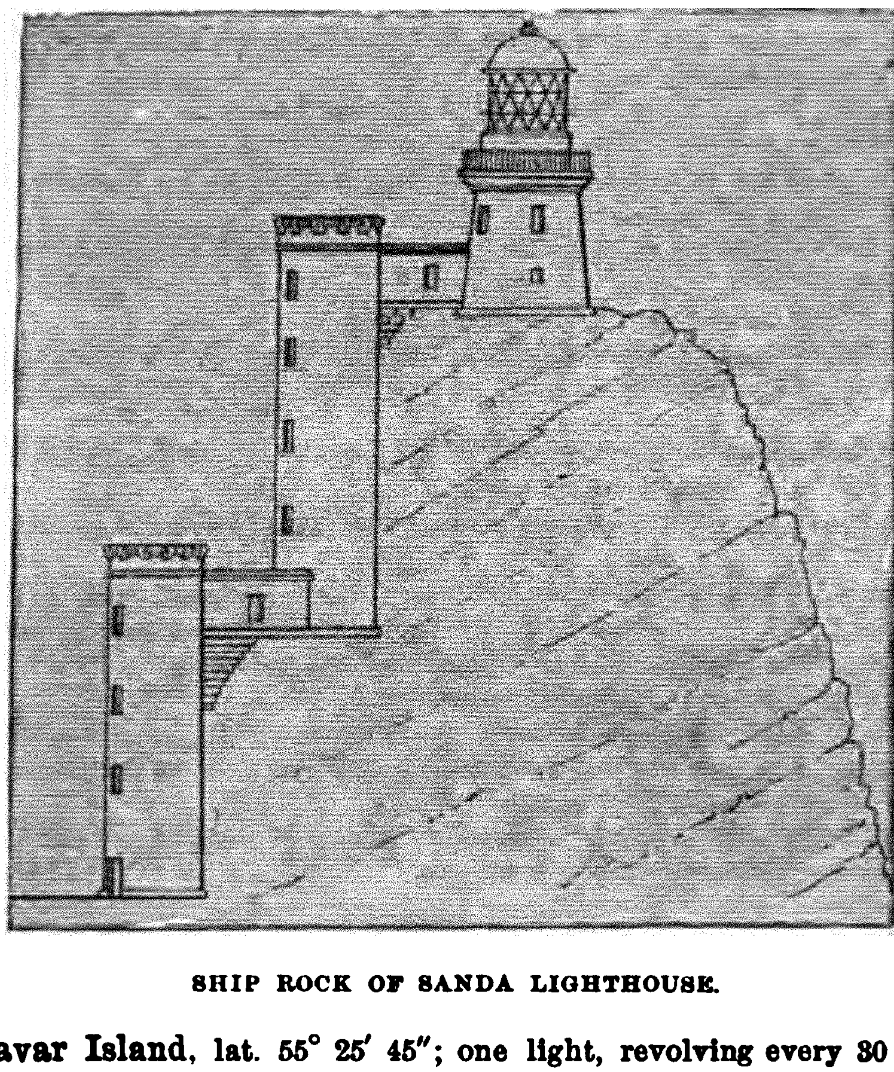
* This lighthouse reflects a light on Arnish Beacon (see p. 274).



WHALSEY SKERRIES LIGHTHOUSE.

261. **Hebrides**, Monach, Shillay Island, lat. 57° 31′ 34″; two lights—the upper flashing every 10 seconds, visible 17 miles; the lower, fixed, visible 12 miles; lighthouse tower, 133 feet high; erected 1814.
262. **Hebrides**, Scalpa, Glass Island, lat. 57° 51′ 25″; one fixed light, visible 16 miles; tower, 100 feet high; erected 1789.
263. **Hebrides**, Ushenish, South Uist, lat. 57° 17′ 35″; one fixed light, visible 18 miles; tower, 39 feet high; erected 1857.
264. **Hebrides**, Barra Head, Bernera Island, lat. 56° 47′ 8″; intermittent light, visible for 2½ minutes, dark for ½ minute; visible 32 miles; stone lighthouse. 60 feet high; erected 1833.
265. **Skerryvore**, lat. 56° 19′ 22″; one light, revolving every minute, visible 17 miles; stone lighthouse, 158 feet high; erected 1844.
266. **Dubhe Artach**, lat. 56° 8′. Now building.
267. **Ardnamurchan Point**, lat. 56° 43′ 38″; one fixed light, visible 18 miles; lighthouse, 118 feet high; erected 1849.
268. **Mull Sound**, Runa Gal Rock, lat. 56° 38′; one fixed light, visible 12 miles; tower, 63 feet high; erected 1857.
269. **Lismore**, Musdile Island, lat. 56° 27′ 19″; one fixed light, visible 14 miles; 86 feet high; erected 1833.
270. **Corran Point**, Loch Eil, lat. 56° 43′ 16″; one fixed light, visible 10 miles; 42 feet high; erected 1860.
271. **Oban**, pier, lat. 56° 25′; two fixed lights; erected 1858.
272. **Phladda Island**, lat. 56° 14′ 48″; one fixed light, visible 11 miles; tower, 42 feet high; erected 1860.

273. **Crinan Canal,** lat. 56° 5′ 30″; one fixed light, visible four miles; ere 1851.
274. **Iron Rock,*** lat. 55° 52′ 30″; one light, revolving every minute, vi 14 miles; 83 feet high; erected 1865.
275. **Rhu Vaal,** Islay Island, lat. 55° 56′ 6″; one fixed light, visible 15 m tower, 113 feet high; erected 1859.
276. **Macarthur's Head,** lat. 56° 56′ 50″; one fixed light, visible 17 m 42 feet high; erected 1861.
277. **Rhynns,** or **Islay,** Oversay Island, lat. 55° 40′ 20″; one light, fl ing every 5 seconds, visible 17 miles: tower, 96 feet high; ere 1825.
278. **Loch-in-Dail,** Dune Point, Islay, lat. 55° 44′ 40″; one fixed light, vi 12 miles; erected 1869.
279. **Port Ellen,** lat. 55° 37′ 13″; one fixed light, visible 11 miles; sq tower, 65 feet high; erected 1853.
280. **Mull of Kintyre,** lat. 55° 18′ 39″; one fixed light, visible 22 miles; 38 high; erected 1787.
281. **Sanda,** Ship Rock, lat. 55° 16′ 30″; one fixed light, visible 17 m 48 feet high; erected 1850.



SHIP ROCK OF SANDA LIGHTHOUSE.

282. **Davar Island,** lat. 55° 25′ 45″; one light, revolving every 30 seco visible 15 miles; stone tower, 65 feet high; erected 1854.

* Sgeirmaoile, or Skeirvuile.

283. **Campbeltown,** pier-head, lat. 55° 25′ 30″; one fixed light.
284. **Ardrishaig,** pier-head, lat. 56° 0′ 45″; one fixed light, visible 4 miles; 19 feet high; erected 1850.
285. **Pladda Island,** lat. 55° 26′; two fixed lights, visible 17 and 14 miles; towers, 95 feet and 43 feet high; erected 1790.

RIVER CLYDE AND FIRTH OF CLYDE—Nos. 286 to 300.

[286. **Cumbrae,** Little Cumbrae Island, lat. 55° 43′ 16″; one fixed light, visible 15 miles; tower, 36 feet high; erected 1757.
287. **Toward Point,** lat. 55° 51′ 45″; one light, revolving every 52 seconds, visible 10 miles; 63 feet high; erected 1812.
288. **Cloch Point,** lat. 55° 56′ 35″; one fixed light, visible 10 miles; tower, 76 feet high; erected 1797.
289. **Greenock,** lat. 55° 57′; two fixed lights, visible 8 miles; erected 1834.
290. **Greenock,** quay; one fixed light, visible 4 miles; 20 feet high; erected 1829.
291. **Greenock,** Garvel Point; one fixed light, visible 7 miles; erected 1867.
292. **Port-Glasgow,** beacon, lat. 55° 56′ 15″; one fixed red light, visible 3 miles; erected 1861.
293. **Broomielaw;** one fixed light, *gas.*
294. **Cardross;** one fixed red light, visible 4 miles; black stone, 34 feet high; erected 1849.
295. ‡ **Garmoyle** Lightship; one fixed light; fixed 1868.
296. **Dumbuck;** one fixed light; erected 1868.
297. **Bowling Bay;** one fixed light, on iron tower, visible 2 miles; erected 1849.
298. **Bowling,** Donald's Quay; one fixed red and bright light; 16 feet high; erected 1869.
299. **Park Quay;** one fixed light; erected 1869.
300. **North Bank,** opposite New-Shot Island; one fixed red light, on iron tower, erected 1869.]

301. **Ardrossan,** breakwater, lat. 55° 38′ 27″; one fixed light, visible 5 miles; tower, 23 feet high; re-built 1856.
302. **Saltcoats,** pier, lat 55° 37′ 52″; one fixed light, visible 6 miles; 18 feet high; erected 1840.
303. **Troon Harbour,** lat. 55° 32′ 55″; two lights, intermittent, 40 seconds bright and 20 seconds eclipsed (*gas*), visible 9 miles; 25 feet high; erected 1827 at inner end of pier; and fixed red light, visible 6 miles, 25 feet high, at pier-head; erected 1848.
304. **Ayr Harbour,** north pier, lat. 55° 28′ 10″; three fixed lights—a tide light, visible 4 miles; erected 1790: two lights in tower, 62 feet high, visible 16 miles; erected 1826, improved 1866.
305. **Loch Ryan,** Cairn Ryan Point, lat. 54° 57′ 45″; one fixed light, visible 10 miles; 50 feet high; erected 1847.
306. **Stranraer,** lat 54° 54′ 40″; three lights on pier, one visible 9 miles.
307. **Corsewall Point,** Loch Ryan, lat. 55° 0′ 29″; one light, revolving every 2 minutes, visible 15 miles; lighthouse tower, 110 feet high; erected 1817.
308. **Port-Patrick,** lat. 54° 50′ 20″; one fixed light, visible 8 miles; stone tower, 30 feet high; erected 1790, re-lighted 1856.
309. **Galloway Mull,** south point, lat. 54° 38′ 9″; one intermittent light, visible 23 miles, eclipsed 30 seconds in every 3 minutes; stone lighthouse, 86 feet high; erected 1830.

310. **Little Ross Island,** lat. 54° 56′; one light, flashing every 5 seconds, visible 18 miles; tower, 65 feet high; erected 1843.
311. **Annan River,** lat. 54° 57′ 50″; one fixed light; erected 1841.

ENGLAND.

WEST COAST.

312. **Skinburness,** near Silloth, lat. 54° 52′ 30″; one fixed light, visible 9 miles; wooden lighthouse, 32 feet high; erected 1841.
313. §**Lee Scar,** lat. 54° 52′; one fixed light, visible 6 miles; 45 feet high; erected 1841.
314. ‡ **Solway** Lightship, lat 54° 48′; one fixed light, red; erected 1841.
315. **Maryport,** south wooden pier, lat 54° 43′; one fixed light (*gas*), visible 6 miles; erected 1796.
316. **Maryport,** south stone pier; one fixed light, visible 12 miles; 35 feet high; erected 1834.
317. **Maryport,** jetty; one fixed light, visible 3 miles; erected 1857.
318. **Maryport,** north tongue; one fixed light (*gas*), visible 3 miles; erected 1857.
319. **Workington,** John Pier and wooden pier, lat. 54° 39′; one fixed light, visible 11 miles; 23 feet high; built in 1825, improved 1866.
320. **Harrington,** pier-head, lat. 54° 37′; one fixed light, visible 11 miles; iron pedestal, 36 feet high; erected 1797.
321. **Whitehaven,** West Pier-head, lat. 54° 33′; one light, revolving every two minutes, visible 19 miles; tower, 47 feet high; erected 1821.
322. **Whitehaven,** North Pier-head; one fixed light.
323. **Whitehaven,** Old Quay; one fixed light.
324. **St. Bees Head,** lat. 54° 30′ 50″; one fixed light, visible 25 miles; tower, 55 feet high; erected 1866.

ISLE OF MAN.

325. **Ayre Point,** lat, 54° 24′ 56″; one light, revolving every 2 minutes, and visible 15 miles; tower 99 feet high; erected 1818.
326. } **Peel,** lat. 54° 13′; one fixed light at entrance, visible 8 miles; erected
327. } 1811; and fixed light (*argand*) on breakwater; erected 1865.
328. **Port Erin;** one fixed green light; erected 1867.
329. **Calf of Man,** Calf Island, lat. 54° 3′; two lights, revolving every 2 minutes, visible 24 and 22 miles; one 70, the other 53 feet high; erected 1818.
330. **St. Mary Port,** pier-head, lat. 54° 4′; one fixed light, visible 9 miles; 18 feet high; erected 1812.
331. **Castletown,** pier-head, lat. 54° 5′; one fixed light, visible 9 miles; 18 feet high; erected 1812.
332. **Derby Haven,** Fort Island, lat. 54° 5′; one fixed light, visible 6 miles; 45 feet in height (during the fishing season only, Aug. 12th to Oct. 10th.)
333. **Derby Haven,** end of breakwater; one fixed light.
334. **Douglas Head,** lat. 54° 9′; one fixed light, visible 14 miles; tower, 65 feet high; erected 1832.

335*a*. **Douglas,** Old Pier-head, lat. 54° 10′; one fixed red light, visible 6 miles; 43 feet high; built 1796; re-built 1865.
335*b*. **Douglas,** Promenade Pier; one fixed blue light; erected 1869.
336. **Douglas,** new landing-pier; one fixed green light; erected 1868.
337*a*. and 337*b*. **Ramsay,** South Pier-head, lat. 54° 20′; fixed red light, visible 4 miles; 27 feet high; (dark stone tower) erected 1845: North Pier-head, one fixed light, visible 9 miles; erected 1868.
338. ‡ **Bahama Bank** Lightship, lat. 54° 20′; two fixed lights, visible 10 miles; fixed 1848.

ENGLAND.

WEST COAST.

Morecambe Bay—Nos. 339 to 345.

[339. **Walney Island,** lat. 54° 2′ 56″; two lights, one revolving every minute and one fixed, visible 13 miles; stone tower, 60 feet high; erected 1790.
340. ‡ **Morecambe Bay** Lightship, lat. 53° 54′; one revolving light, flashing every 30 seconds, visible 10 miles; fixed 1863.
341. **Poulton,** stone pier, lat. 54° 4′ 20″; one fixed light, visible 8 miles; stone tower, 50 feet high; erected 1851.
342. ‡ **Lightship,** lat. 54° 1′ 20″; one fixed red light; fixed 1854.
343. **Lune River,** Cockerham Promontory, and Plover Scar Rock, lat. 53° 59′; two lights, distance 834 yards; one lighthouse of wood, erected 1847; the other of stone.
344. §**Wyre River,** north-east elbow of North Wharf bank, lat 53° 57′ 14″; one fixed light, visible 10 miles; erected 1840.*
345. **Fleetwood,** lat. 53° 55′ 36″; two fixed lights, visible 13 and 9 miles; upper, stone lighthouse, and red lantern; lower, stone colour; erected 1841.]

346. **Ribble River,** north-east of entrance, lat. 53° 44′ 38″; one intermittent light, every 4 minutes, visible 12 miles; erected 1865.

* It was this lighthouse, we presume, which underwent so extraordinary an accident on Saturday, February 19th, 1870. About half-past ten A.M., the schooner *Elizabeth and Jane,* of Preston, approached the mouth of the channel opposite Fleetwood. Adjoining the channel mouth, and about three miles from the latter town, is situated a lighthouse upon screw piles. When about half a mile off the lighthouse, the captain of the schooner found he was drifting towards it, and, spite of all his exertions, he was unable to change her course, as the tide flowed rapidly inwards, and a dead calm prevailed. Before the anchor could get a "hold," the ship ran bow foremost into the piles, which were all shattered by the collision, and taking up the body of the lighthouse—a huge sexangular timber frame, filled in with windows, and surmounted with "a large revolving (?) light"—carried it away on her forecastle. Two keepers were in the lighthouse, but neither was hurt. The vessel, however, was greatly injured, and some alarm was felt lest she should sink. However the accident was seen from the shore; a tug steamer came to her assistance, and, with the lighthouse on board, she was towed into port. Until a new structure can be raised, a lightship will be stationed in a suitable locality.

347. **Ribble River,** New Pier; light shown about 2 hours before to 1½ hours after high water.
348. **Ribble River,** Lytham, lat. 53° 44′ 10″; one fixed light.

MERSEY AND DEE RIVERS, ENTRANCE—NOS. 349 to 361.

[349. ‡ **Liverpool,** North-west Lightship; lat. 53° 29′ 30″; one light, revolving every minute, visible 11 miles; fixed 1814.
350. ‡ **Formby** Lightship, lat. 53° 31′ 40″; one fixed light, visible 8 miles; fixed 1834.
351. ‡ **Crosby** Lightship, lat. 53° 30′ 40″; three fixed lights, visible 8 miles; fixed 1840.
352. **Crosby Point,** lat. 53° 31′ 25″; one fixed light, visible 12 miles; lighthouse tower, 74 feet high; erected 1856.
353. **Air Point,** lat. 53° 22′; one fixed light, visible ten miles; circular tower, 65 feet high; erected 1776.
354. **Hoylake,** lat. 53° 23′ 40″; two fixed lights, visible 13 and 11 miles; towers, 64 feet and 42 feet high; erected 1763.
355. **Leasowe,** lat. 53° 24′ 49″; one fixed light, visible 15 miles; lighthouse 110 feet high; erected 1763.
356. **Bidston,** lat. 53° 24′; one fixed light, visible 23 miles; stone lighthouse, 68 feet high; erected 1771.
357. **Rock,** lat. 53° 26′ 43″; one light, revolving every minute, visible 14 miles; 94 feet high; erected 1830.
358. **Birkenhead,** New Ferry Pier; one fixed light.
359. **Runcorn,** Old Quay, lat. 53° 20′; one fixed light; erected 1863.
360. ‡ **Runcorn** Lightship; one fixed light; fixed 1866.
361. **Woodside Ferry**; one fixed light; erected 1863.]

362. **Great Orme Head,** North Point, lat. 53° 20′ 35″; one fixed light, visible 24 miles; square castellated stone lighthouse; erected 1862.
363. **Menai,** Trwyn-Du Point, lat. 53° 18′ 51″; one fixed light, visible 9 miles; circular castellated tower, 96 feet high; erected 1837.
364. **Beaumaris,** pier, lat. 53° 15′ 45″; one fixed red light.
365. **Lynus Point,** lat. 53° 25′; one intermittent light, visible 8 seconds, obscured 2 seconds, visible 16 miles; castellated tower, 36 feet high; erected 1835.
366. **Amlwch Port,** north pier, lat. 53° 25′; one fixed light, visible 9 miles; erected 1817.
367. **Skerries Island,** lat. 53° 25′ 18″; one fixed light, visible 16 miles; circular tower, 75 feet high; erected 1714.
368. **Holyhead,** New Breakwater; one fixed light, visible 4 miles; erected 1850.
369. **Holyhead,** wooden jetty; one fixed light; erected 1864.
370. **Holyhead,** inner harbour, port side; one fixed light, green; erected 1866.
371. **Holyhead,** inner harbour, starboard side; one fixed light, red; erected 1866.
372*a*. **Stack Rock,** off north-west point of Holyhead Island, lat. 53° 18′; one light, revolving every 2 minutes, visible 20 miles; circular tower, 84 feet high; erected 1809. ["During foggy weather, a *bell* is sounded, and a smaller *bright light*, revolving in 1½ minutes, is occasionally shown about 40 feet above the sea, and 30 yards north of the main lighthouse. A gun is also fired from the North Stack every hour and half-hour during foggy weather; and, when the mail packets are expected, every quarter of an hour, from 10.45. A.M. till 45 minutes past noon; and again from 11.45 P.M. till 1.45 A.M."]

179. **Dunbar,** Old Harbour, lat. 56°; one fixed light (*gas*), visible 5 miles; 27 feet high; erected 1857.
180. **Dunbar,** Victoria Harbour; one fixed light, *gas*.

FIRTH OF FORTH—Nos. 181 to 207.

[181. **Cockenzie,** pier-head; one fixed green light, visible 8 miles.
182. **Fisherrow,** pier-head, lat. 55° 56′; fixed light; erected 1839.
183. **Leith,** East Pier, inner part, lat. 55° 59′; one fixed light, visible 8 miles; 19 feet high; erected 1758.
184. **Leith,** East Pier-head; one fixed green light; visible 8 miles.
185. **Leith,** West Pier; one fixed light, visible 10 miles; 19 feet high; erected 1829.
186. **Newhaven,** pier-head, lat. 55° 59′; one fixed light, visible 5 miles; 29 feet high.
187. **Granton,** pier-head; one fixed light, visible 6 miles; 40 feet high; erected 1845.
188. **Granton,** breakwater; two fixed red lights; 12 feet high.
189. **Inchkeith Island,** lat. 56° 2′; one light, revolving every minute, visible 20 miles; stone lighthouse, 58 feet high; erected 1804.
190. **Grangemouth**; one fixed light, visible 10 miles; stone tower, 30 feet high; erected 1847.
191. **Charleston,** outer pier; one fixed light; erected 1866.
192. **Inverkeithing,** West Quay, two fixed red lights; erected 1856.
193. **St. David**; one fixed light; erected 1866.
194. **Burntisland,** East Pier-head, lat. 56° 4′; one fixed light, visible 8 miles; 25 feet high; erected 1860.
195. **Burntisland,** Ferry Pier; one fixed light; 9 feet high.
196. **Burntisland,** New Pier; one fixed light; erected 1867.
197. **Pettycur,** pier; one fixed light; erected 1854.
198. **Kirkcaldy,** East Pier-head, lat. 56° 7′; one fixed light (*gas*), visible 8 miles.
199. **Dysart**; one fixed green light, *gas*.
200. **West Wemyss,** pier-head; one fixed red light.
201. **Buckhaven,** East Pier-head, lat. 56° 10′ 6″; one fixed light; iron tower, 9 feet high; erected 1854.
202. **St. Monans,** lat. 56° 12′ 30″; two fixed lights, visible 6 miles.
203. **Pittenweem,** East Pier-head, lat. 56° 13′; one fixed light, visible 6 miles; erected 1853.
204. **Pittenweem,** saw-mill, one fixed light, visible 6 miles; erected 1853.
205. **East Anstruther,** West Pier-head, lat. 56° 13′ 16″; two fixed lights (*gas*), visible 4 miles; erected 1848.
206. **Cellardyke,** lat. 56° 14′; one fixed red light, *gas*.
207. **Isle of May,** lat. 56° 11′ 9″. Lighthouse on summit of island—one fixed light, visible 21 miles; 78 feet high; erected 1816. Lighthouse on north-east side—one fixed light, visible 15 miles; 36 feet high; erected 1844.]

208. **Bell Rock,** lat. 56° 26 3′; one light, revolving every two minutes, visible 15 miles; 117 feet high; erected 1811.
209. **St. Andrews,** pier-head, lat. 56° 20′ 3″; one fixed red light, visible 6 miles; 18 feet high; erected 1825.
210. **St. Andrews,** Cathedral turret; one fixed light, visible 5 miles; erected 1849.

Firth of Tay—Nos. 211 to 215.

[211. **Buddonness,** lat. 56° 28′; two fixed lights, visible 15 and 12 miles; one on tower, 104 feet high, erected 1820; the lower one, 65 feet high.

212. **Port-on-Craig,** lat. 56° 27′; two fixed lights, visible 12 and 10 miles; one on tower, 76 feet high; one on piles, 53 feet high; erected 1820 and 1845.

213. **Newport,** West Ferry Pier, lat. 56° 26′; two fixed lights, visible 8 and 7 miles.

214. **Dundee Harbour,** Middle and East Piers, lat. 56° 28′; two fixed lights, visible 8 and 7 miles.

215. **Dundee,** Camperdown Docks; two fixed red lights, *gas;* erected 1865.]

216. **Arbroath,** Outer Harbour, lat. 56° 33′; one fixed light, visible 8 miles; stone tower, 22 feet high; erected 1826.

217. **Arbroath,** Inner Harbour; two fixed lights.

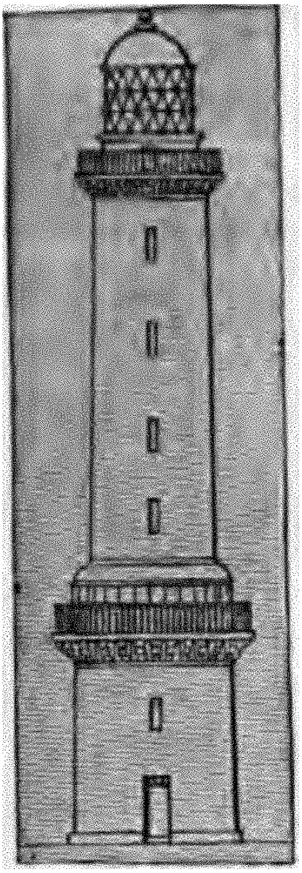
218. **Ness,** Scurdyness, lat. 56° 42′; one fixed light; erected 1870.*

219. **Montrose,** north side of harbour; two fixed lights, visible 11 and 10 miles; 65 and 39 feet high; erected 1818.

220. **Stonehaven,** harbour, lat. 56° 58′; two fixed lights, visible 8 miles; erected 1839.

* We condense the following report from the *Dundee Advertiser,* March 1, 1870:—

"On Tuesday night the Scurdyness Lighthouse, at the entrance to Montrose Harbour, was lit up for the first time, amid the rejoicings of the people of Montrose and Ferryden. From early morning the vessels in the harbour displayed numerous flags, and more than the usual stir was observable among the villagers on the opposite side of the river. Indeed, seldom have the Ferryden people manifested so much enthusiasm; but it is seldom that they have so much cause to rejoice. The want of a light at the Scurdyness has long been felt by the seafaring community. The rock-bound shore stretching between the Bell Rock and the Girdleness—a distance of nearly fifty miles—is perhaps one of the most dangerous parts of the east coast of Scotland, and has been the scene of numerous shipwrecks and great loss of life. At no point within these limits have so many disasters occurred as at the entrance to Montrose Harbour, now fortunately protected by the Scurdyness Light. Bounded on the one side by large outlying and in some instances hidden rocks, and on the other by a long stretch of sandy shore, whilst the channel itself is extremely narrow, the entrance to Montrose Harbour is very difficult for navigation, and particularly so when the weather is boisterous. Moreover, on the north side, and within a very short distance of the newly-erected lighthouse, is the Annat—a sandbank on which many vessels have been wrecked in attempting to make the harbour. The necessity, therefore, for a light on Scurdyness was very great, and has been long and deeply felt. Situated at the Point, on the southern side of the channel, the lighthouse, a substantial building, commands a clear-weather range of seventeen nautical miles. It is built on solid rock, the foundation being of stones from Benholm Quarry, and the tower itself of white brick. The entire height of the tower is about 100 feet and the lighthouse about 30 feet—in all, 130 feet from base to vane. The diameter at the base is 23 feet 2 inches, whilst at the top it is 16 feet. A spiral stair of about 140 steps leads to the top of the tower, after which the ascent



GIRDLENESS LIGHT-HOUSE.

221. **Girdleness**, lat. 57° 8′ 15″; two lights, visible 19 and 16 miles; stone lighthouse, 120 feet high; erected 1833.
222. **Aberdeen**, North Pier-head, lat. 57° 8′ 20″; one fixed light, visible 8 miles; white tower, 29 feet high; erected 1866.
223. **Aberdeen**, ferry; two fixed lights, 8 miles; erected 1842.
224. **Buchanness**, lat. 57° 28′ 15″; one light, flashing every 5 seconds, visible 16 miles; 115 feet high; erected 1827.
225. **Peterhead**, South Harbour, lat. 57° 30′; one fixed light, visible 10 miles; 26 feet high; erected 1834.
226. **Peterhead**, North Harbour: one fixed light, visible 10 miles; 32 feet high; erected 1849.
227. **Fra**[illegible] head and Middle Pier, lat. 57° 41′ 30″; two fixed red lights, visible 5 miles; erected 1841.
228. **Kinnaird Head**, lat. 57° 41′ 51″; one fixed light, visible 15 miles; 76 feet high; erected 1787.
229. **Macduff**, North Pier-head, lat. 57° 40′; one fixed light, visible 6 miles.
230. **Banff**, North Pier-head, lat. 57° 40′; one fixed light, visible 8 miles, erected 1832.
231. **Banff**, New Harbour, lat. 57° 40′ 5″; two fixed lights; erected 1851.
232. **Elgin and Lossiemouth**, South Pier-head; one fixed green light; erected 1838.
233. **Covesea Skerries**, Craig Head, lat. 57° 43′ 15″; one light, revolving every minute, visible 18 miles; stone lighthouse 18 feet high; erected 1846.
234. **Chanonry**, Point, lat. 57° 34′ 30″; one fixed light, visible 11 miles; stone lighthouse, 42 feet high; erected 1846.
235. **Cromarty**, lat. 57° 4[illegible]′; one fixed light, visible 9 miles; 42 feet high; erected 1846.
236. **Tarbet Ness**, lat. 57° 51′ 54″; one intermittent light, visible 2½ minutes, dark ½ minute; visible 15 to 18 miles; tower, 134 feet high; erected 1830.
237. **Little Ferry**, lat. 57° 56′; two fixed lights.
238. **Latheronwheel**, South Head, lat. 58° 16′ 10″; one fixed light; erected 1852.

to the various stories is by ladders. There is a room near the top, in which are deposited the stores. The light is fixed and white, of the second order (dioptric), and the mechanism for supplying the lamp with oil is of the most interesting nature. Oil is pumped up to the wick by clock-work; and an alarm sounds during the whole time the machine is in motion, so that any irregularity is immediately announced to the attendant. The light will be seen from about S W. ¼ S., round by the east to about N.E. ¼ N.. or as far as the land will permit. The bearings are magnetic, and from the vessel. A light of weaker power will be shown from the channel towards Montrose Har-

239. **Wick,** North Pier-head, lat. 58° 26′; two fixed lights (*gas*), visible 8 miles; 34 feet high; erected 1851.
240. **Noss Head,** lat. 58° 28′ 38″; one light, revolving every half minute, visible 18 miles; 68 feet high; erected 1849.
241. **Pentland Skerries,** island, 58° 41′ 22″; two fixed lights, visible 18 and 16 miles; high light, 118 feet high; low light, 88 feet high; 33 yards distant; erected 1794.
242. **Dunnet Head,** lat. 58° 40′ 16″; one fixed light, visible 23 miles; 66 feet high; erected 1831.
243. **Holburn,** Little Head, Thurso Bay, lat. 58° 36′ 50″; one light, flashing every 10 seconds, visible 13 miles; 55 feet high; erected 1862.
244. **Orkney Isles,** Cantick Head, Hoy Isle, lat. 58° 47′; one light, revolving every minute, visible 15 miles; brick lighthouse, 73 feet high; erected 1858.
245. **Orkney Isles,** Hoy Sound, lat. 58° 56′ 9″; two fixed lights, visible 15 and 11 miles; high light, Gremsa Isle, north-east point, 108 feet high, erected 1851; low light, Gremsa Isle, north-west point, 38 feet high.
246. **Orkney Isles,** Kirkwall, lat. 58° 59′ 10″; one fixed light, visible 9 miles; 27 feet high; erected 1854.
247. **Orkney Isles,** Auskerry, Stronsa Firth, lat. 59° 2′; one fixed light, visible 16 miles; brick lighthouse, 112 feet high; erected 1867.
248. **Orkney Isles,** Start Point, Sanday Isle, lat. 59° 16′ 39″; one fixed light, visible 15 miles; 91 feet high; erected 1806.
249. **Orkney Isles,** North Ronaldsha, lat. 59° 23′ 15″; one light, flashing every 10 seconds, visible 17 miles; brick lighthouse, 139 feet high; erected 1854.
250. **Shetland Isles,** Sumburgh Head, lat. 59° 51′; one fixed light, visible 22 miles; stone lighthouse, 55 feet high; erected 1821.
251. **Shetland Isles,** Bressay, lat. 60° 6′ 10″; one light, revolving every minute, visible 17 miles; brick lighthouse, 98 feet high; erected 1854.
252. **Shetland Isles,** Whalsey Skerries, lat. 60° 25′ 24″; one light, revolving every minute, visible 17 miles; brick tower, 98 feet high; erected 1854.
253. **Shetland Isles,** North Unst, lat. 60° 51′ 20″; one fixed light, visible 21 miles; 64 feet high; erected 1854.
254. **Cape Wrath,** north-west point of Scotland, lat. 58° 37′ 30″; one light, revolving every two minutes, visible 30 miles; tower, 65 feet high; erected 1828.
255. **Ru Stoer,** lat. 58° 14′ 10″. Now building.

NORTH COAST.

256. **South Rona Island,** lat. 57° 34′ 31″; one light, flashing every 12 seconds, visible 20 miles; tower, 42 feet high; erected 1857.
257. **Kyle Akin,** Gillieam Island, lat. 57° 16′ 39″; one fixed light, visible 11 miles; 70 feet high; erected 1857.
258. **Oronsay Island,** lat. 57° 8′ 39″; one fixed light, visible 12 miles; 63 feet high; erected 1857.
259. **Hebrides,** Butt of Lewis, north point, lat. 58° 30′ 40″; one fixed light, visible 18 miles; lighthouse tower, 120 feet high; erected 1862.
260. **Hebrides,** Stornoway, Arnish Point,* lat. 58° 11′ 28″; one light, revolving every 30 seconds, visible 12 miles; 45 feet high; erected 1852.

* This lighthouse reflects a light on Arnish Beacon (see p. 274).

474. **Warren Point**; one fixed red light; erected 1861.
475. §**Red Castle**; one fixed light; erected 1852.
476. §**White Castle**; one fixed light; erected 1848.
477. §**Ture**; one fixed light; erected 1850.
478. §**Cunnyberry**, one fixed light; erected 1848.
479. **Culmore Point**; one fixed light, on mast; erected 1848.
480. **Culkeeragh**; one fixed light; erected 1851.
481. **Boom Hall**; one fixed light; red brick tower; erected 1859.
482. ‡**Rosse Bay** Lightship; one fixed light; fixed 1859.
483. **Rock Mill** (near); one fixed light, on mast; erected 1859.]

484. **Inistrahull Island**, lat. 55° 25′ 55″; revolving every 2 minutes; 42 feet high; erected 1812.
485. **Lough Swilly**, Fanad Point, lat. 55° 16′ 33″; one fixed light, visible 14 miles; 26 feet high; erected 1816.
486. **Tory Island**, lat. 55° 16′ 26″; one fixed light, visible 16 miles; lighthouse, 87 feet high; erected 1832.
487. **Aranmore Island**, Rinrawros Point, lat. 55° 0′ 52″; one light, flashes every 20 seconds, visible 18 miles; circular tower, 76 feet high; erected 1865.

WEST COAST.

488. **Rathlin-o-Birne Island**, lat. 54° 39′ 47″; one fixed light, visible 16 miles; circular tower, with dome, 63 feet high; erected 1856, altered 1864.
489. **Killybegs**, St. John's Point, lat. 54° 34′ 8″; one fixed light, visible 14 miles; 47 feet high; erected 1831.
490. **Killybegs**, Rotten Island, lat. 54° 36′ 51″; one fixed light, visible 12 miles; 47 feet high; erected 1838.
491. **Sligo Bay**, Black Rock, lat. 54° 18′; one fixed light, visible 13 miles; lighthouse tower, 47 feet high; erected 1838.
492. **Sligo Bay**, Oyster Island, lat. 54° 18′ 5″; two fixed lights, visible 17 miles; each tower 43 feet high; erected 1837.
493. **Broadhaven**, Gubacashel Point, lat. 54° 16′; one fixed light, visible 12 miles; 50 feet high; erected 1855.
494. **Eagle Rock**, lat. 54° 17′; two fixed lights, visible 20 miles; one 87 feet, the other 64 feet high; 132 yards distant.
495. **Black Rock**, lat. 54° 4′ 10″; revolving light, with flash every 30 seconds, visible 23 miles; circular tower, 50 feet high; erected 1864.
496. **Blacksod Point**, lat. 54° 5′ 54″; one fixed light, visible 10 miles; granite tower and dwelling, 41 feet high; erected 1866.
497. **Clare Island**, lat. 53° 49′ 30″; one fixed light, visible 27 miles; 39 feet high; erected 1806.
498. **Inishgort**, lat. 53° 49′ 34″; one fixed light, visible 10 miles; 26 feet high; erected 1827.
499. **Slyne Head**, Illaunimmul Island, lat. 53° 23′ 58″; two lights, one revolving every 2 minutes, visible 15 miles; one fixed, visible 14 miles; each tower 79 feet high, 142 yards apart; erected 1836.

GALWAY BAY—NOS. 500 to 502.

[500. **Eeragh Island**, West Point, lat. 53° 8′ 55″; one light, revolving every 3 minutes, visible 16 miles; circular tower, 101 feet; erected 1857.

501. **Inisheer,** South Point, lat. 53° 2′ 40″; one fixed light, visible 15 miles; circular tower, 112 feet high; erected 1856.

502. **Mutton Island,** lat. 53° 15′ 13″; one fixed light, visible 10 miles; 34 feet high; erected 1817.]

RIVER SHANNON—Nos. 503 to 507.

[503. **Loophead,** lat. 52° 33′ 38″; one fixed light, visible 22 miles; circular white tower, 75 feet high; erected 1853.

504. **Kilcradan Point,** lat. 52° 34′ 47″; one fixed light, visible 16 miles; 43 feet high; erected 1824.

505. **Scattery Island,** Rinana Point. Now building.

506. **Tarbert,** Rock, lat. 52° 35′ 30″; one fixed light, visible 13 miles; 54 feet high; erected 1834.

507. **Beeves,** Rock, lat. 52° 39′; one fixed light, visible 10 miles; 40 feet high; erected 1854.]

508. **Tralee,** Samphire Island, lat. 52° 16′ 14″; one fixed light, visible 5 miles; circular lighthouse, erected 1834.

509. **Tearaght Island,** lat. 52° 4′. Now building. Will be lighted, probably, in the autumn of 1870.

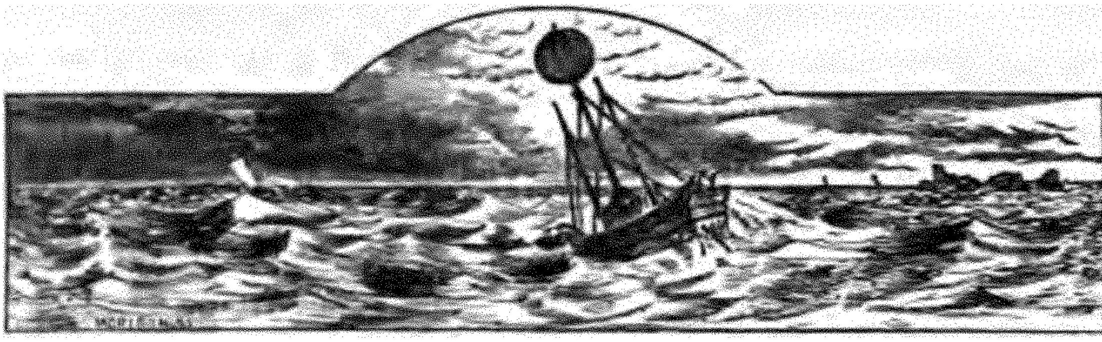
510. **Valentia,** Cromwell's Fort, lat. 51° 56′; one fixed light, visible 12 miles; lighthouse 48 feet high; erected 1841.

511. **Skelligs Rock,** lat. 51° 46′ 14″; two fixed lights, the upper visible 25 miles, and lighthouse 48 feet high; the lower, visible 18 miles, and 46 feet high. The upper will be extinguished when Tearaght is completed.

512. **Calf Rock,** lat. 51° 34′ 10″; one light, flashing every 15 seconds; visible 17 miles; circular tower, painted red, with white belt; 102 feet high; erected 1866.

513. **Bantry Bay,** Roancarrig Island, lat. 51° 39′ 10″; one fixed light, visible 12 miles; circular tower, 62 feet high; erected 1847.

514. **Crookhaven,** Rock Island Point, lat. 51° 28′ 35″; one fixed red light, visible 10 miles; lighthouse, 45 feet high; improved 1867.



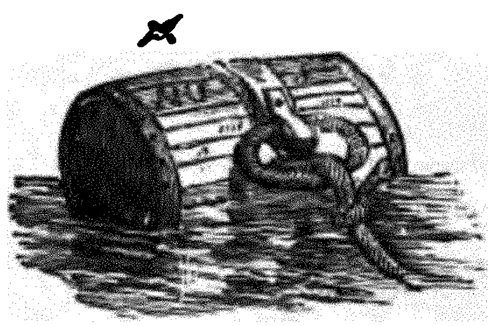
II.

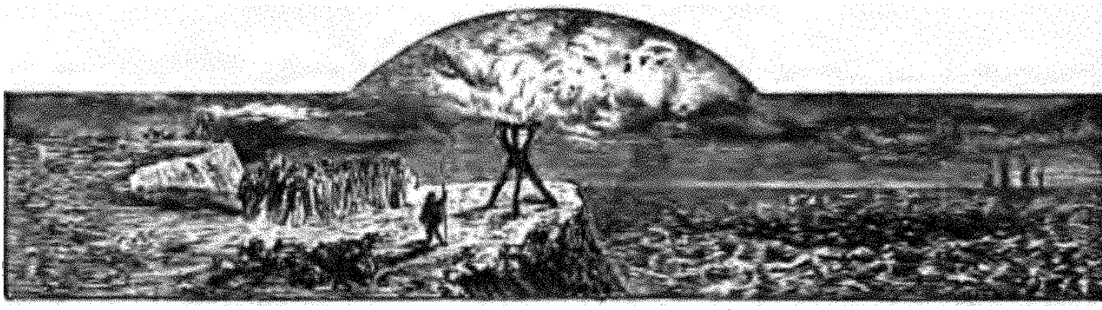
A NIGHT IN A LIGHTSHIP.

WHILE these sheets were passing through the press there appeared in the *Scotsman* a graphic and interesting sketch of "A Night in the Gull Lightship, off the Goodwin Sands," from the able and popular pen of Mr. R. M. Ballantyne (March 26, 1870). The following extracts cannot fail to be acceptable to the reader :—

"A little before midnight on Thursday (the 24th), while I was rolling uneasily in my 'bunk,' contending with sleep and sea-sickness, and moralising on the madness of those who choose 'the sea' for a profession, I was roused—and sickness instantly cured—by the watch on deck suddenly shouting down the hatchway to the mate, 'Southsand-Head light is firing, sir, and sending up rockets.' The mate sprang from his 'bunk,' and was on the cabin floor before the sentence was well finished. I followed suit, and pulled on coat, nether garments, and shoes, as if my life depended on my own speed. There was unusual need for clothing, for the night was bitterly cold. On gaining the deck, we found the two men on duty actively at work—the one loading the lee gun, the other adjusting a rocket to its stick. A few hurried questions from the mate elicited all that it was needful to know. The flash of a gun from the Southsand-Head lightship, about six miles distant, had been seen, followed by a rocket, indicating that a vessel had got upon the fatal Goodwins. While the men spoke, I saw the bright flash of another gun, but heard no report - owing to the gale carrying the sound to leeward. A rocket followed, and at the same moment we observed the light of the vessel in distress just on the southern tail of the Sands. By this time our gun was charged, and the rocket in position. 'Look alive, Jack; get the poker,' cried the mate, as he primed the gun. Jack dived down the companion hatch, and in another moment at the first alarm. Jack applied it in quick succession to the gun and the rocket. A blinding flash and deafening crash were followed by the whiz of the rocket, as it sprang with a magnificent curve far away into the surrounding darkness. This was our answer to the Southsand-Head light, which, having fired three guns and three rockets to attract our attention, now ceased firing. It was also our note of warning to the look-out on the pier of Ramsgate Harbour. 'That's a beauty,' said our mate, referring to the rocket; 'get up another, Jack; sponge her well out, Jacobs, we'll give 'em another shot in a few minutes.' Loud and clear were both our signals, but four and a half miles of distance and a fresh gale neutralized their influence. The look-out did not see them. In less than five minutes the gun and rocket were fired again. Still no answering signal came from Ramsgate. 'Load the weather gun,' said the mate. Jacobs obeyed, and I sought shelter under the lee of the weather bulwarks, for the wind appeared to be composed of penknives and needles. Our third gun thundered forth, and shook the lightship from stem to stern; but the rocket struck the rigging and made a low wavering flight. Another was therefore sent up, but it had scarcely cut its bright line across the sky when we observed the answering signal—a rocket from Ramsgate Pier.

"'That's all right *now*, sir; *our* work is done,' said the mate, as he went below, and quietly turned in, while the watch, having sponged out and recovered the gun, resumed their active perambulation of the deck. I confess that I felt somewhat disappointed at the sudden termination of the noise and excitement! I was told that the Ramsgate lifeboat could not well be out in less than an hour. It seemed to my excited spirit a terrible thing that human lives should be kept so long in jeopardy, and, of course, I began to think, 'Is it not possible to prevent this delay?' There was nothing for it, however, but patience, so I turned in 'all standing,' as sailors have it, with orders that I should be called when the lights of the tug should come in sight. It seemed but a few minutes after, when the voice of the watch was again heard shouting hastily, 'Lifeboat close alongside, sir. Didn't see it till this moment. She carries no lights.' I bounced out, and minus coat, hat, and shoes, scrambled on deck just in time to see the Broadstairs lifeboat rush past us before the gale. She was close under our stern, and rendered spectrally visible by the light of our lantern. 'What are you firing for?' shouted the coxswain of the boat. 'Ship on the sands, bearing south,' replied Jack, at the full pitch of his stentorian voice. The boat did not pause. It passed with a magnificent rush into darkness. The reply had been heard, and the lifeboat shot straight as an arrow to the rescue. We often hear and read of such scenes, but vision is necessary to enable one to realize the full import of all that goes on. Again all was silent and unexciting on board of the *Gull*. I went shivering below, with exalted notions of the courage and endurance of lifeboat men. Soon after, the watch once more shouted, 'Tug's in sight, sir;' and, once again, the mate and I went on deck. The Ramsgate lifeboat *Bradford* was in tow far astern. As she passed us, the brief questions and answers were repeated for the benefit of the coxswain of the boat. I observed that every man in the boat lay flat on the thwarts except the coxswain. No wonder. It is not an easy matter to sit up in a gale of wind, with freezing spray, and sometimes green seas, sweeping over one. They were, doubtless, wide awake and listening; but, as far as vision went, that boat was manned by ten oilskin coats and sou'-westers. A few seconds took them out of sight; and thus, as far as the *Gull* lightship was concerned, the drama ended. There was no possibility of our ascertaining more, at least during that night, for whatever might be the result of these efforts, the floating lights had no chance of hearing of them until the next visit of their tender. I was therefore obliged to turn in once more, at 3 A.M. Next forenoon we saw the wreck, bottom up, high on the Goodwin Sands." It was that of the good ship *Germania* of Bremen.





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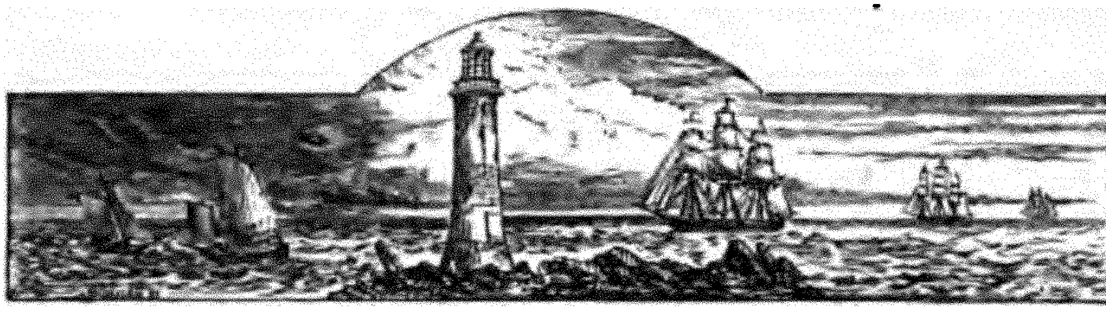

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