

INDEX.

- ABERBROTHOCK ABBEY, 238.
 Aberdeen Harbour, 130.
 Adam, Robert, architect, 78, 80, 97, 98.
 Adie, Alexander, optician, 51, 192.
 Admiralty Survey, appeal for, 199.
 ——— Memoir of, 201.
 Airy, Sir G. B., 52.
 American Suspension Bridges, 163.
 Anderson, Dr., 5, 6.
 Anemometer, 257.
 Annan Bridge, 160.
 Ardrossan Harbour, 130.
 Argand lamps. *See* Lighthouse Illumination.
 Astronomical Institution of Edinburgh, origin of, 265.

 BACKWATER, value of, 131.
 Balance crane, 181, 182.
 Barclay, Dr. John, 119, 270.
 Barnbogle, foreshore, 241.
 Base line, measurement of, 196.
 Baxter, Mr., architect, 78.
 Beaufort, Sir F., 202.
 Bell Rock Lighthouse :—Dangers of the rock, 13, 15 ; ballad of Sir Ralph the Rover, 13, 274 ; "Account" of, 14 ; Mr. Stevenson's design of 1800 for a stone tower, 16 ; improvements on Smeaton's tower in design and arrangement of materials, 16-24 ; Bill of 1802-3 thrown out on financial grounds, 18 ; Mr. Telford and Mr. Rennie called in to support Mr. Stevenson's design, 18 ; Act passed in 1806, 19 ; progress of the work, 25 ; attending boat breaks adrift, 27 ; life in the floating lightship, 31 ; boating between lightship and the rock, 37 ; Mr. Stevenson's anxiety for the workmen, 39 ; Sunday work, 40 ; life in the barrack or beacon, 42 ; cranes invented for the work, 45, 181 ; bust of Engineer placed in the tower by the Lighthouse Board, 45 ; Sir Walter Scott's visit to the tower, and lines inscribed in the album, 47 ; experiments on preservation of timber, 155 ; experiments on iron, 159 ; measurement of base line for ascertaining its distance from the shore, 196 ; cement rubble cofferdams used at, 252 ; observations on fog and fog signals, 254 ; Southey's "Inchcape Rock," 274.
 Benson, Mr. (Covent Garden Theatre), 61.
 Birkenhead Docks, 132-150.
 Blackwood, W., publisher, 3.
 Blair, Sir D. Hunter, 3.
 Blasting, 203.
 Bolts, unscrewing of, by the waves, 252.
 Bremonteuil, M., 246.
 Bridges :—Mr. Stevenson's designs for Marykirk, Annan, Stirling, and

- Hutcheson stone bridges, 160; high level road bridge for Newcastle, 161; bridge of built planks, 162; new form of suspension bridge, 162-165; paper on suspension bridges, 162; provision for flood waters, 239.
 Buoyage system, Mr. Stevenson's, 253.
 Burn, Mr., architect, 238, 239.
- CANALS:—Mr. Stevenson's Reports on, upon one level without lockage, 111; Strathmore, 111; Edinburgh and Glasgow, 111; ship canals, 125; canal between the Dee and Mersey, 132-150.
 Carr Rock Beacon:—Design for, and tide machine for ringing bell or sounding a whistle, 177.
 Cast iron rails. *See* Railways.
 Cast iron tracks. *See* Roads.
 Cathcart, Viscount, 247.
 Catoptric system. *See* Lighthouse Illumination.
 Cement. *See* Mortar.
 Clerk, John, of Eldin, 14, 15, 21, 22, 114.
 Coal light. *See* Isle of May.
 Cockburn, Lord, 76.
 Cofferdams, cement rubble, 252.
 Colby, Colonel, 62, 202.
 'Comet' steamer, accident to, 258.
 Corran Ferry, 235.
 Covent Garden Theatre, 60.
 Cramond Suspension Bridge, 162, 165.
 Cranes:—Moveable jib and balance cranes invented by Mr. Stevenson, 45, 181.
 Creech, Mr., 3.
 Crichton, Mr., architect, 91, 92.
 Cubitt, Sir W., 265.
 Cumbrae Lighthouse, 2, 5.
 Cycloidal talus wall, 242.
- DAVIDSON, Rev. Dr., 2.
 Dee, River (Cheshire), 130, 132-150.
 ——— wasting effects of the sea at, 225.
 Dee, River (Aberdeenshire), density of salt and fresh water at, 229.
 Dioptric system. *See* Lighthouse Illumination.
 Double light, 58.
 Douglass, J. N., C.E., 47, 176.
 Dredging, 203.
 Duff, Sheriff, 238, 271, 274.
 Duncan, Sheriff, 190.
 Dundee Harbour, 130, 249, 251.
- EARL'S PALACE, Kirkwall, 238.
 East Lothian Railway, 124.
 Eddystone Lighthouse, Mr. Stevenson's inspection of, in 1813 and 1818, 46; fears as to its security, 46; to be rebuilt, 47.
 Edgeworth, R., 66.
 Edinburgh Astronomical Institution, origin of, 265.
 Edinburgh, Mr. Stevenson's design for approaches from the east by Regent and London Roads, and opening up access to the Calton Hill, 74; sites for the new Jail, Court of Justiciary, and buildings in Waterloo Place, 77; Regent Bridge, 88; Feuing Plan for eastern district of Edinburgh, 90; improvement of accesses from the west and north and from Granton, 90; removal of Old Tolbooth Prison, 91; proposal to remove the University buildings, 95.
 Edinburgh Railway, 114.
 Edinburgh and Glasgow, canal between, 111.
 Elliot, A., architect, 76.
 Erne, River, 130.
 Erskine, Lord Advocate, 19, 271.

INDEX.

279

- FACET reflector, 49.
 Fenwick, Mr., 160.
 Ferries, 101; Ferry Engineering illustrated by Mr. Stevenson's Report on the Tay Ferries, 102; Reports on various ferries, 108; Orkney and Shetland Ferry, 108.
 Fisheries:—Mr. Stevenson on the Scottish fisheries, 184; origin of the Shetland herring fishery, 189; sympiesometer suggested as a storm warning for fishing boats, 191; habits of fishes, 193; gases in air sacs of fishes, 194; Dr. Handyside's remarks on, 194; Hon. B. F. Primrose on the slow progress of the Shetland fisheries, 195.
 Flashing light, invention of, by Mr. Stevenson, 57.
 Floating light lantern, 58, 59.
 Fog and fog signals, observations on, 254.
 Foreshores, protection of, 241.
 Forth, River, 130, 253.
 Foulerton, Captain, Trinity House, 259.
 Fowler, J., C.E., 131.
 Fraserburgh Harbour, 130.
 Fresnel, A., 62.
- GERMAN OCEAN, the alveus or bed of, 204, 205.
 Graham, J. Gillespie, architect, 238.
 Granton Harbour, 90, 130.
 Gregory, Professor, 89.
- HALDANE, J., architect, 15.
 Hamilton, T., architect, 76.
 Hamilton, Sheriff, 271, 272.
 Handyside, Dr. P. D., 194.
 Harbours, Mr. Stevenson's Reports on various, 130; value of spending basins for, 130.
 Harris, Mr., 60.
- Henderson, Professor, 268.
 Highland and Agricultural Society, 127, 246.
 Hope, Lord President, 17, 18, 269.
 Hope, Professor, 7.
 Hutcheson Bridge, 160.
 Hydraulic mortar, 240.
 Hydrophore, Mr. Stevenson's invention of, 231-235.
- INGLIS, Colonel, 269.
 Intermittent light, invention of, by Mr. Stevenson, 57.
 Irish Channel, cause of heavy seas in, 247; sea routes across, 248.
 Iron, experiments on the durability of, 159.
 Isle of Man Lighthouses, 8.
 — observations on fog at, 256.
 Isle of May Lighthouse, 3, 53, 58.
- JAMESON, Professor, 7.
 Joseph, Samuel, R.A., 45.
- KINCAID, Mr., 246.
 Kinnairdhead Lighthouse, 5, 49, 196.
- LAING, S., 185, 195.
 Leach, Dr., 155.
 Leslie, Sir J., 51, 100.
 Lifeboats, 260.
 Lighthouse Illumination:—early modes of, 48; facet reflectors and lamps, 49; silvered copper reflectors and Argand lamps, 49; sliding lamp carriage, 51; coal lights, 53; distinctions among lights, 57; dioptric system, 62.
 Lightship lantern, Mr. Stevenson's design for, 58, 59.
Limnoria terebrans, ravages of, on timber, 155.

- Lipping of joints of masonry, 239.
 Loch Eil, 235.
 Locomotive engine, 124.
 Lockhart, J. G., 270.
 London and Edinburgh, railway between, 125.
 Low, Professor, 7.
- M'ADAM, J. L., 66, 67, 70.
 Mackenzie, Murdoch, 138 *et seq.*
 Manby's apparatus, 261, 262.
 Marine Surveying, 196; measurement of base line for Bell Rock, 196; fixing site of Kinnairdhead light, 196; appeal for Admiralty Survey, 199; history of Admiralty Survey, 201.
 Marjoribanks, Sir J., 89, 95.
 Marykirk Bridge, 69, 160, 239.
 Melville, Lord, 126, 168.
 — Monument, Edinburgh, 238.
 Mersey, River: Reports on harbour and dock at Wallasey and the Dee, with connecting ship canal, 132-150; wasting effects of the sea at, 225.
 Montrose Bridge, 159, 240.
 — church spire, 238.
 Mortar, hydraulic, 240.
 Moveable jib crane, 181, 182.
 Mowat, Mr., of Gardie, 190.
 Mullaghmore Harbour, 245.
- NEILL, P., LL.D., 3, 7, 270.
 Netherlands, King of, 58.
 Newcastle, design for high level road bridge at, 161.
 New York Suspension Bridge, 167.
 Niagara Suspension Bridge, 167.
 Night signal lamps, 247.
 Nimmo, Alexander, C.E., 132, 135, 225, 265.
 North Berwick Harbour, 250.
 Northern Lighthouse Board, origin of, 4;
- Mr. Smith appointed Engineer, 4; first light exhibited by, 5; Mr. Stevenson appointed Engineer, 7; annual inspections and reports on the lighthouses, 7; send Mr. Stevenson on a visit to the English lights, 7; Bell Rock Lighthouse, 12; improvements in lighthouse illumination adopted by, 49; lighthouses designed by Mr. Stevenson, 56; Minute on the death of Mr. Stevenson, 273.
- ORDNANCE SURVEY, 202.
 Orkney and Shetland Ferries, 108.
 — Fisheries, 185, 189, 195.
- PALMERSTON, Lord, 245.
 Pentland Skerries Lighthouse, 6.
 Peterhead Harbour, 130.
Pinus maritima major, for checking sand drift, 245.
 Playfair, Mr., architect, 76.
 Playfair, Professor, 7, 15, 16, 96, 100, 252, 267.
 Population, prospective increase of, 250.
 Portpatrick Harbour, 130, 247, 248.
 Price, H., C.E., 131.
 Primrose, Hon. B. F., 195.
- QUEENSFERRY passage, signal lamps for, 247.
- RAE, Sir William, 77, 91, 114, 174, 238, 258, 259.
 Rails, cast and malleable iron, 122, 123, 128.
 Railways on one level, 112; haulage on, 112; lines of railway in Scotland laid out by Mr. Stevenson, 112; Report on Edinburgh Railway, 114; cast iron and malleable iron rails, 122, 123, 128; locomotive, 124; Reports on various

INDEX.

281

- railway lines, 124, 125; uniform gauge, etc., proposed for, 126; notes on railways for the Highland and Agricultural Society, 127; description of permanent way of, 128; letter from George Stephenson, 128; article on, 203; signal lamps, 247.
- Reflectors. *See* Lighthouse Illumination.
- Rendel, J. M., 151.
- Rennie, George, 265.
- Rennie, John, 18, 20, 21, 22, 265.
- Ribble, River, 130.
- Ritchie, Professor, 7.
- Rivers, Mr. Stevenson's Reports on, 130; value of backwater, 131; Tees navigation, 131; Reports by Telford, Stevenson, and Nimmo, on harbours and wet docks at Birkenhead and at the Dee with connecting ship canal, 132; improvement of the Tay navigation, 151; experiments on the density of fresh and salt water, 229.
- Roads:—Early roads and road making, 64; Edgeworth and M'Adam's systems of road making, 66; Mr. Stevenson's system of road making, 67-70; cast iron tracks, 68; stone tracks as a smooth and durable city road, 71; article on, 203.
- Robison, Professor, 3, 7, 15.
- Rosebery, Lord, 241.
- SALT water, density of, in estuaries and rivers, 229.
- Sand drift, checking of, by "bent" grass and planting *Pinus maritima major*, 245.
- Scotch Lighthouse Board. *See* Northern Lighthouse Board.
- Scott, Sir Walter, 25, 47, 94, 238, 270.
- Section planography, 205.
- Severn, River, 130.
- Shetland Ferries. *See* Ferries.
- Shetland Fisheries, 185; origin of herring fishery, 189.
- Ships, build of, 249.
- Shipwrecks, notes on, 260.
- Signal lamps, 247.
- Sinclair, Sir John, 125.
- Skerryvore Lighthouse, 271, 272.
- Smeaton, John, 21, 23, 24, 206, 236.
- Smith, Captain of the 'Orestes,' 168 *et seq.*
- Smith, Thomas: improvements in lighthouse illumination, 3, 4, 49; Engineer to the Scotch Lighthouse Board, 4; Cumbrae Lighthouse, 5; Pentland Skerries Lighthouse, 6.
- Smyth, Professor Piazzini, 265.
- Southey's "Inchcape Rock," 274.
- Spink, J., Bell Rock pilot, 30.
- St. Andrews Cathedral, 238.
- St. Magnus Cathedral, 238.
- Steamboats, 107; regulations for, 258; lights for, 259.
- Stephenson, George, 121, 124, 128.
- Robert, 161.
- Stevenson, Alan, 151, 271.
- Stevenson, Robert:—birth, 1; superintends erection of Cumbrae Light, 2, 5; resolves to be a Civil Engineer, 5; student at Andersonian Institution, Glasgow, and University of Edinburgh, 5-7; superintends Pentland Skerries Lighthouse works, 6; appointed Engineer to the Northern Lighthouse Board, 7; annual inspections and Reports on the Scotch Lighthouses, 7; inspection of and report on English lights, 10; is taken for a French spy, 10; Journals, 12; Reports, 12.
- Design for the Bell Rock Lighthouse. personal superintendence of the work during its execution, and incidents connected therewith, 13-47; "Account" of, 14.
- Lighthouse illumination, improve-

ments in, 49; sliding lamp carriage, 51; lighthouses in Scotland designed by, 56; invents distinctions for lighthouses, viz., flashing, intermittent, and double lights, 57; design for floating light lantern, 59; Report on dioptric system of illumination, 62.

System of road making, 67-70; cast iron tracks for roads, 68; stone tracks, 71.

Improvement of Edinburgh:—design for approaches from the east by Regent and London Roads, and opening up access to Calton Hill, 74; Report on sites for new Jail and Court of Justice and buildings in Waterloo Place, 77; building plan for eastern district of Edinburgh, 90; improvement of accesses from the north and west and from Granton, 90; visit to the jails of England, 91; Old Tolbooth Prison, 91; Report on removal of University buildings, 95.

Ferries:—Reports on, illustrated by those of the Tay, 102; Reports on various ferries, 108.

Report on canals on one level without lockage, 111; Reports on railways, 112; uniform gauge, etc., proposed for railways, 126; notes on railways for the Highland and Agricultural Society, 127; description of permanent way, 128.

Harbours and Rivers:—Reports on, 130; Tees navigation, 131; Reports on harbour and wet docks at Birkenhead, and harbour at Helbre on the Dee with connecting ship canal, 132-150; Tay river improvements, 151.

Preservation of timber:—experiments on, 154; preservation of iron, 159.

Bridges:—designs for Marykirk, Annan, Stirling, and Hutcheson stone bridges, 160; design for high level

road bridge at Newcastle, 161; bridge of built planks, 161; new form of suspension bridge, 162, 165.

Design for Wolf Rock Lighthouse, 168.

Design for Carr Rock Beacon, 177; proposal to use the tide for tolling a bell or sounding a whistle, 178.

Invents the moveable jib and balance cranes, 181.

Fisheries:—notes on the Scotch, 184; origin of the Shetland herring fishery, 189; suggestion for using the sympiesometer as a storm warning, 91; experiments on air sacs of fishes, 194.

Marine survey, 196; measurement of *base line*, 196; mode of ascertaining positions of lighthouses, 196; appeal for Admiralty Survey and Sailing Directions, 199.

Contributions to *Encyclopædia Britannica* and *Edinburgh Encyclopædia*, 203; *alveus* or bed of the German Ocean, 204, 205; *sectio planography*, 205; wasting effects of the sea on the estuaries of the Mersey and Dee, 225; discovery that the salt water flows up the beds of rivers in a stream distinct from the outflowing fresh water, 229; invents the hydrophore, 231.

Wide range of subjects on which Mr. Stevenson gave advice, 236; architectural reports, 236; extracts from early Reports, 239.

Retrospect of life, 264.

Stewart, Professor Dugald, 7, 97.

Stirling Bridge, 160.

Stockton and Darlington Railway, 125.

Stonehaven Harbour, 130.

Stone tracks. *See* Roads.

Strathmore Canal, 111.

— Railway, 124.

Suspension Bridges. *See* Bridges.

Sympiesometer, 191.

INDEX.

283

- TAY Ferries, 102.
 — River, 130, 151, 251.
 Tees, River, 130, 131.
 Telford, Thomas, 18, 127, 132, 149, 265.
 Thames, River, 234.
 Thomas, Captain, Admiralty Survey, 140, 201.
 Tidal scour, 251.
 Timber :—experiments on durability of, 155; ravages of the *Limnoria terebrans* on, 157; charring, 158; creosoted 159.
 Tour de Cordouan, 49, 63.
 Trinity, cycloidal sea wall at, 242.
- WALKER, James, C.E., 73, 176, 265.
 Water :—experiments on the density of fresh and salt water at the Dee, 229; Thames, Loch Eil, etc., 235; hydrophore for obtaining specimens of, 231.
 Watt, James, 125, 126, 167.
 Waves, action of, in unscrewing bolts, 252.
 Wear, River, 130.
 Wilson, Captain, 43.
 Winch Chain Bridge, 163.
 Wolf Rock Lighthouse :—design for, 168; Journal of visit to, 168-175; tower built in 1870, 175.