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THE ARCHITECT, ENGINEER, AND OPERATIVE BUILDER'S CONSTRUCTIVE MANUAL

Or, A Practical and Scientific Treatise on the Construction of Artificial Foundations for Buildings, Railways, Etc.

Christopher Davy

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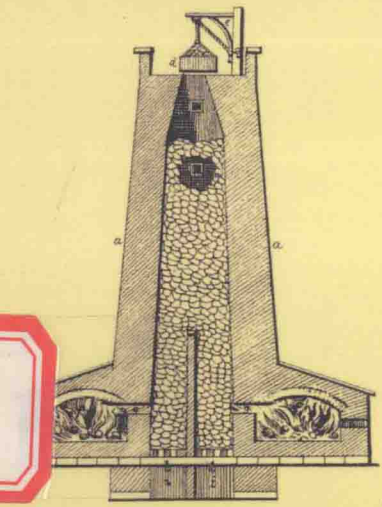

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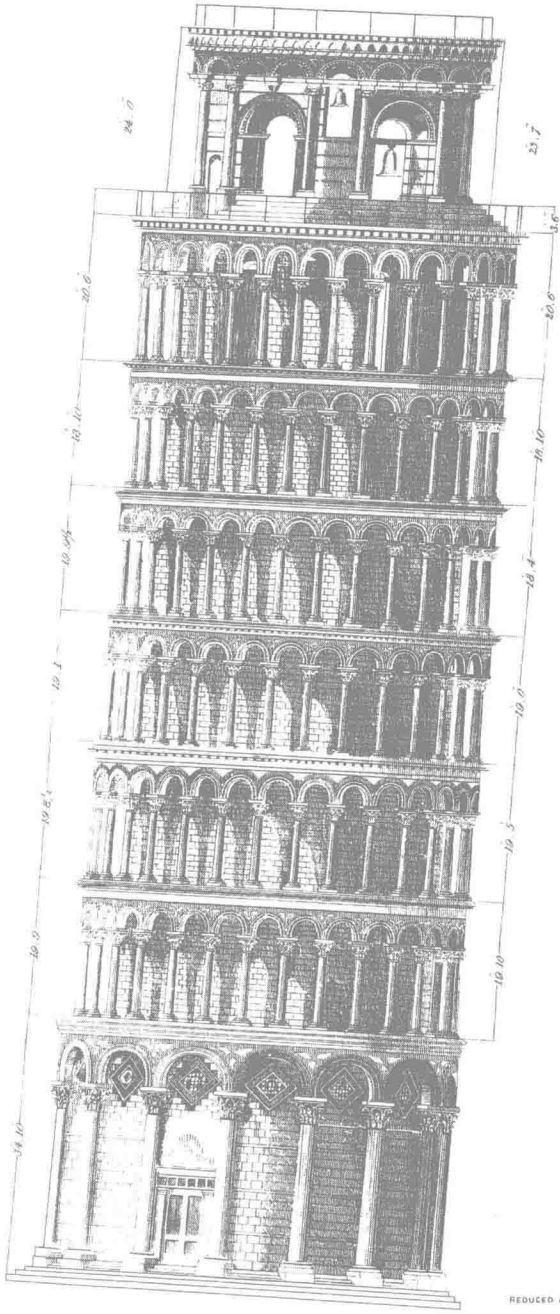

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THE

ARCHITECT, ENGINEER,

AND OPERATIVE BUILDER'S

CONSTRUCTIVE MANUAL,

OR, A

PRACTICAL AND SCIENTIFIC TREATISE

ON THE

CONSTRUCTION OF ARTIFICIAL FOUNDATIONS FOR BUILDINGS, RAILWAYS, &c.

WITH A COMPARATIVE VIEW OF THE APPLICATION OF PILING AND CONCRETING TO SUCH PURPOSE; ALSO AN INVESTIGATION OF THE NATURE AND PROPERTIES OF THE MATERIALS EMPLOYED IN SECURING THE STABILITY OF BUILDINGS. THE WHOLE ILLUSTRATED BY EXAMPLES SELECTED FROM THE MOST IMPORTANT ARCHITECTURAL AND ENGINEERING WORKS OF THIS COUNTRY.

TO WHICH IS ADDED,

AN ANALYSIS OF THE PRINCIPAL LEGAL ENACTMENTS AFFECTING THE OPERATIONS OF THE PRACTICAL BUILDER. ILLUSTRATED BY NOTES OF CASES OCCURRING IN ACTUAL PRACTICE.

By CHRISTOPHER DAVY,
ARCH. & C.E.

PART I.

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ADVERTISEMENT.

The ramification of railways throughout the kingdom has so extended the sphere of the engineer's operations, as to render a knowledge of the geological formations peculiar to each county through which his passage lies, of considerable, nay, of essential importance. Geological knowledge is now to the engineer indispensable, inasmuch as it forms the source from which his supplies must be drawn, and, at the same time, forms the index by which may be ascertained the nature of that foundation upon which his construction is to rest.

In the ordinary routine of architectural practice, it is notorious that information of this kind has been rarely sought for until the time has arrived for carrying the intended works into execution. The uncertainty and delay incident to this mode of inquiry, has not unfrequently entailed ruinous consequences upon both architect and builder. If proofs were wanting, we should be prepared to show from specifications on the one, and breach of contracts on the other side, instances of defective information, and consequent difficulties and extravagance of

execution, fully corroborative of this opinion. It is evident, therefore, that the engineer should be prepared with such information as will enable him to avail himself of the resources of each particular district, and to apply them with promptitude and decision.

The calcareous and siliceous deposits of this country have hitherto received but little attention from the profession; and we may add, that with respect to the nature and properties of the materials, we are as yet "upon the threshold of our knowledge."

The great and increasing demand for geological information applicable to architectural and engineering purposes, has induced the author to prefix to the following Treatise a Register* of the principal geological formations in each of the counties of England and Wales, with observations on the quality of the materials to be derived therefrom, and applicable to the purposes of building; also, the situation of the principal stone quarries, lime works, &c.

In compiling this "Register," the author has attempted to give a concise view of the resources of each county, in order that the draft of the specifications for important works may be made with

* In consequence of the extent occupied by this additional matter, (which has much exceeded our original plan,) the "Introduction," which is chiefly historical, is deferred till the publication of the second part of the "Treatise."

greater accuracy than heretofore, and that the builder may be directed to the sources from which he may obtain his materials with facility and economy.

To trace the extent and disposition of the strata, the engineer must necessarily consult an accurate geological map; for this purpose, the "Index Map," by J. Phillips, Esq., F.R.S., G.S., and the large map by Messrs. Walker, will supply much valuable information.

The reader will perceive, from the authorities which are given, that the author has, in the following compilation, freely availed himself of such information as was afforded by reference to the works of the most eminent writers on geological science; and having, also, visited and carefully examined most of the northern and western counties of England during the last two summers, he trusts that the variety of facts and data thus collected and brought under immediate observation, may meet with the approbation of the members of that profession to which he has the honour to belong.

3, *Furnival's Inn, Nov.*, 1838.

A REGISTER

OF THE PRINCIPAL GEOLOGICAL FORMATIONS IN EACH OF THE COUNTIES OF ENGLAND AND WALES, WITH OBSERVATIONS ON THE QUALITY OF THE MATERIALS TO BE DERIVED THEREFROM, AND APPLICABLE TO THE PURPOSES OF BUILDING; ALSO, THE SITUATION OF THE PRINCIPAL STONE QUARRIES, LIME WORKS, &c.

Northumberland.

THE county of Northumberland contains, 1. *Mountain or carboniferous limestone.* 2. *Coal.* 3. *Basaltic and porphyritic trap.* And, 4. *Old red sandstone,* with the accompanying beds of conglomerates, gritstones, variegated marls, and cornstones.

The building materials supplied by this county chiefly consist of limestone, limestone marble, and sandstones. The quarries are plentifully distributed throughout the county. Limestone abounds in the districts of Bamborough Ward and part of Glendale Ward, east of the river Till; it is also quarried at the following places:—Sprouston, Stodridge, Shilbottle, Long Franlington, Hartburn, Ryall, Corbridge, and Aldstone Moor. Blue, red, gray, and brown whinstone is procured from Bamboroughshire, the

Cheviot mountains, and adjacent places. It is generally employed for repairing the roads.

The limestones of Northumberland vary considerably in quality; they may be classified in the following order:—1. Highly crystalline. 2. Slightly crystalline. 3. Ferruginous. 4. Bituminous. And, 5. Calcareo-siliceous. The strongest lime is to be obtained from the calcination of Nos. 3 and 4. The crystalline varieties are best adapted for wrought masonry or architectural façades. For engineering works, or the substructure of important buildings, the sandstones, associated with the carboniferous deposits, are highly valuable. The following are the varieties:—1. *Slate sill*—a fine-grained micaceous, slaty rock, of a gray colour, used as a roofing slate in many villages of Northumberland and Durham. It is the uppermost bed in the section of Heley field. 2. *Freestone sills*—fine-grained quartzose sandstones, used for building. 3. *Hazles*—hard, ferruginous, fine-grained sandstones. 4. *Millstone grit*—a coarse, white, quartzose sandstone; it crops out on the Derwent, and is quarried for millstones. The quarries are at Muggleswick Fell, and between Wolsingham and Stanhope, in Weardale. A similar rock is found at Scramerstone, in the north-eastern part of Northumberland, and at Craster, near Howick. The castle of Dunstanborough is built with this stone. 5. *Grindstone sill*—a fine-grained yellowish sandstone found at Aldstone Moor (Durham), Coalcleugh, Allenheads (Northumberland), Nent-

head, and on the summit of Cross Fell. The grindstones made from this material are said to be much inferior to those of Newcastle.

Below the limestone, in the Aldstone Moor section (Durham), are the following sandstones:—1. *Whetstone sill*—a fine-grained micaceous sandstone, at Burtreeford. 2. *Ironstone sill*—a ferruginous sandstone, containing an abundance of iron pyrites. 3. *Firestone*—a fine-grained, porous sandstone, used for furnaces. 4. *Pattison's sill*—a very hard, gray sandstone, containing mica. 5. The *coal sills*—similar to the above. And, 6. *Water sill*, or *tuft*—a very porous, soft, light-coloured sandstone.

The durability of sandstone chiefly depends upon its texture or state of induration. It has been remarked,* that when a porous sandstone is exposed to the weather, or placed in such situations where water may enter and penetrate its crevices, mere change of temperature will cause much mischief; but on the occurrence of a frost, the expansion becomes so great, that a single winter may cause a disaggregation of the entire mass.

Durham.

The county of Durham contains, 1. *Coal.* 2. *Millstone grit.* 3. *Magnesian limestone.* 4. *Mountain limestone.* And, 5. *Trap.*

* See Brande's Journal, vol. iii., p. 381.

The *great limestone* of Frosterley, in Weardale (Durham), is a dark gray shelly marble, extensively quarried for lime, ornamental purposes, &c.; it contains 96 per cent. of carbonate of lime. The *scar limestone* is similar to the above; it crops out in the Nent rivulet. The *cockle-shell limestone*—a dark, iron-gray, shelly limestone; it crops out on Aldstone Moor. The *Tyne-bottom limestone*—an encrinal limestone of three strata; it forms the bed of the Tyne for four miles, from Tyne Head to Garrigill Gate. *Robinson's great limestone* and the *Melmerby scar limestone*, are carboniferous beds of considerable thickness; the former is the lowest in the Dufton section, and the latter bassets out at Melmerby Cliff. At this place the bed is twenty-one fathoms in thickness. An account of the magnesian limestone of Durham, and an analysis of some specimens will be found in the 4th chapter of this Treatise. Magnesian limestone, when calcined, produces lime possessing peculiar properties, which are hereafter noticed. As a material for masonry, it is much superior to the tender oolitic varieties of the west of England. The atmosphere acts with much less intensity upon the fine-grained and magnesian limestone than upon the coarser and oolitic kinds. The superficial hardening which takes place upon the surface of the Bath oolite, when exposed to the weather, is very deceptive, inasmuch as it is followed by a rapid disaggregation of the stone. The *Castle* of *Clare*, in the county of Suffolk, is in

part built with magnesian limestone. A portion of one of the bondstones from the *keep* of that structure, was procured by the author during the past summer. Upon examination it was found nearly perfect, while a specimen of oolite from the same building crumbled to calcareous sand. This building was erected some time previous to the year 1190.

The millstone grit and other sandstones of the county of Durham do not differ materially from the sandstones of Northumberland already described; such variations as occur being more interesting to the geologist than to the engineer, we omit any further notice of them.

The sandstone from the Heddon (Heddon-on-the-Wall) quarries, Northumberland, must not, however, be omitted in our Register. This stone is a hard, light-coloured quartzose sandstone, with rather a coarse grain, but admirably adapted for engineering works. Some of the earliest edifices in the county, constructed with this stone, yet remain to attest its durability.

The quarries recently opened at Heddon communicate with the Tyne river by a railway. The basalt, graywacke, new and old red sandstone, &c., are chiefly worked and employed for local purposes. The other materials will be described in the account of those counties where such formations assume a greater importance.

Cumberland.

Cumberland contains, 1. *New and old red sandstone.* 2. *Trap.* 3. *Granite.* And, 4. *Clay slate.* The principal free stone quarries (chiefly red and white siliceous and quartzose grits), are in the neighbourhood of Whitehaven; from whence it is shipped to various places. Quarries for grindstone grits are situated near Ivegill and Barngill. The blue slate quarries are at Bassenthwaite, Borrowdale, Buttermere, Cockermouth, and Ulpha. In this county there is also coal and its accompanying limestone, but the principal deposits from which building stone is drawn are the new and old red sandstone formations.

Westmoreland.

Westmoreland contains formations similar to the above, with the addition of a development of the Silurian system. These rocks furnish, 1. *Micaceous sandstones, limestones,* and *sandy shales.* 2. *Subcrystalline limestone shale.* 3. *Gritstones,* then *limestones* and *sandstones.* And, 4. *Calcareous* and *argillaceous flags.* The prevailing stratrum of the southern and eastern parts of the county is carboniferous limestone, associated with quartzose grits. Limestone marble is quarried within three miles of Kendal, also near Ambleside, and a bituminous limestone near Kirby Lonsdale and Ken-

dal Fell. The great slate quarries occupy the western mountains; whinstone and slate is also procured from the north western mountains. The dark gray limestone of Windermere and its vicinity is quarried for lime—chimney pieces, &c., red felspathic granite, and another variety, much harder, and of a green colour, occurs at Wasdale.

Yorkshire.

Yorkshire contains, 1. *Coal.* 2. *Millstone grit.* 3. *Carboniferous limestone.* 4. *Trap.* 5. *Mountain* and *magnesian limestones.* And, 6. *Clays and crag.* Building materials may be obtained as follows. Quarries of freestone and millstone grit are to be found at and near Gatherley Moor, near Richmond, Renton near Boroughbridge, west of Sheffield, Penistone, Huddersfield, Bradford, Otley, Harrowgate, Ripley, Masham, Rainton quarry, Pateley quarry, Moorstone quarry, all within a few miles of Ripon. Quarries at Bramley, Mexborough, Holton, Kirby, Leeds, Idle, and Sheffield; all these are quartzose grits. Magnesian limestone quarries, Brodsworth, Quarry Moor, Ripon, and at Doncaster. Mountain limestone quarries—Roach Abbey and near Richmond, &c. Limestone and marble are also found in the Western Moorlands. A roofing flag slate (siliceous) is dug near Wensleydale. Lias is sufficiently near to be procured for lime.

Lancashire.

Lancashire contains, 1. *Coal.* 2. *Millstone grit.* 3. *Mountain* and *magnesian limestones.* 4. *New red sandstone.* The quarries of freestone are situated in that part of the county south of the sands. Flagstones are also raised in the same district. Blue slate quarries are most numerous in the northern parts of High Furness.

Anglesea.

Anglesea contains, 1. *Gneiss.* 2. *Mica schist.* 3. *Granite.* 4. *Coal.* 5. *Old red sandstone.* 6. *Carboniferous* or *mountain limestone.* 7. *Trap.* And, 8. *Clay slate.*

The quarries of the Isle of Anglesea have furnished a crystalline limestone, which appears well adapted for architectural façades; its use, however, has as yet been very limited, arising probably from the expense of carriage or freight. The most noted edifice erected with this material is the Birmingham Town Hall.

Caernarvon.

Caernarvon contains, 1. *Graywacke.* 2. *Trap.* 3. *Gneiss.* And, 4. *Mica schist.*

The great bulk of building materials employed in this country is derived from calcareous and