A GUIDE

TO THE

EXHIBITION GALLERIES

IN THE

BRITISH MUSEUM (NATURAL HISTORY),

CROMWELL ROAD, SOUTH KENSINGTON.

DEPARTMENTS OF GEOLOGY AND PALÆONTOLOGY, MINERALOGY, AND BOTANY.

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INTRODUCTION.

THE building now open to the public for the display of the collections connected with Natural History gradually formed in the British Museum owes its origin to the difficulty of expansion of the structure in Bloomsbury. The British Museum was founded in the year 1753, when the site allotted for it seemed amply sufficient for its purposes. The Library of Books and Manuscripts was at that time the principal feature of the institution, and the conception of a combined Museum of Library, Antiquities, and Natural History was imperfectly realised. But with the growth of scientific and archæological studies, and the general spread of education, the importance of the formation of ample collections of ancient sculpture and objects illustrating the life and manners of races of men in remote ages, and not less of bringing together and systematically arranging specimens of the various products of nature, obtained fuller recognition. Then it was found that the space required for a universal Library—for a collection of Manuscripts, to include State Papers, and Topographical and Genealogical collections—for general Antiquities, including the sculptured remains of ancient temples and palaces—for collections of Coins and Medals—of Prints and Drawings—and for the various departments of Natural History, exceeded by a great deal what this had been estimated at a century earlier. *Cause of erection of present building.*

The question of an extension of the Museum building came frequently to the surface before it was fairly considered by the Government. The strain was first felt in the Library. The energetic action of the Keeper of that Department, Mr. *Growth of Library.*

Panizzi, in demonstrating its great deficiencies, strengthened so greatly his appeal for the means of making them good, that in the year 1847 the Trustees were enabled to obtain an annual grant for the purpose on a munificent scale. But the existing accommodation for books was already exhausted, and it was only after long discussion, and the consideration of many suggestions for providing more space, that the scheme, conceived by Mr. Panizzi, of covering the greater part of the Museum inner quadrangle was adopted, and the magnificent Reading-Room with its surrounding galleries gave the required relief to the over-crowded Library.

This erection was completed in the year 1857, when it had already become apparent that an equal or greater effort would have to be made to find exhibition space for other departments. Besides that the collections of Coins and

ecession f Sculp- ure.

Medals, and Prints and Drawings, so instructive for art and archæology, were not shown to the public at all, massive sculpture was yearly being received in overwhelming quantities from buried cities of Assyria and Asia Minor, and from the site of ancient Carthage, and these with other precious antiquities were being stored in disfiguring sheds placed within the colonnade of the principal façade, or were perforce consigned to obscure vaults in the basement. It became evident that either the Museum building must be greatly enlarged, or that portions of the collections must be removed to another locality.

pace re- iired for atural istory llections.

The Keeper of Antiquities had reported, on the 8th of July, 1856, "that if the Department of Antiquities is to remain in Bloomsbury, it will be necessary to secure the whole of the ground lying to the west and south-west of the Museum." Reports from Keepers of Natural History collections were equally urgent, at the same period, for provision of space for the exhibition of their specimens. During the year 1857 the

ans sug- sted.

Trustees considered plans for giving relief to the Natural History departments; and in January 1858 they recommended the adoption of Mr. Sydney Smirke's suggestion to purchase the houses in Montague Place, to the north of the Museum, even if the increase of the collections should at some future time make it necessary to transfer any of them to some other place. But the idea of a separation of the collections was already freely entertained. In June of the same year the Trustees discussed the question of removing the Botany to Kew. In the same month, Mr. Panizzi, then Principal Librarian, recommended the purchase of the buildings and ground on three sides of the Museum, estimating the cost, with proposed new buildings, at from £700,000 to £800,000; and at the same time urged the discontinuance of collecting mediæval antiquities and ethnography. Suggestions even, from without, were heard for transferring minerals to the Government School of Mines, stuffed animals to the Zoological Society's care, and insects and shells to that of the Linnæan Society. The expedient of a severance of the collections, however, was not approved at that time by the leading men of science, who, in a memorial to the Government numerously signed, and dated on the 6th of July, 1858, made strong objections to the separation of the Natural History collections.

Report by Professor Owen.

At this juncture a great impulse was given to the agitation for an enlargement of the Museum by an elaborate report submitted to the Trustees by Professor Owen, dated on the 10th of February, 1859, showing the proportionate space required for each department of Natural History, and accompanied with a plan of internal arrangement. The total area required by this scheme amounted to 300,000 superficial feet; and to these Professor Owen proposed to add considerably by providing for a circular building, 150 feet in diameter, for an exhibition of type specimens, forming as it were an epitome of Natural History, as well as for offices and libraries. The report was circulated in print, and the Government was appealed to. A special general meeting of the Trustees, held on the 22nd of November, 1859, appointed a Committee to consider the cost of purchasing five or eight acres of ground, either contiguous to the Museum or at South Kensington. The necessity for either a great extension of the existing building or the acquisition of a fresh site and separation of the Natural History collections was pressed on all sides, and admitted by the

Resolution to separate Natural History collections.

Government. At a special general meeting, held on the 21st of January, 1860, many members of the Government sitting as official Trustees, a resolution, moved by the First Lord of the Treasury, was carried, "That it is expedient that the Natural History Collections be removed from the British Museum, inasmuch as such an arrangement would be attended with considerably less expense than would be incurred by providing a sufficient additional space in immediate contiguity to the present building of the British Museum." The estimated cost of the required ground on three sides of the Museum was £240,000, that of five or eight acres at South Kensington £25,000 and £40,000 respectively.

Select Committee of House of Commons.

No immediate action was taken on this resolution. In order to obtain fuller assurance of the best method of proceeding, a Select Committee of the House of Commons was appointed in the session of the same year, 1860, with instructions to inquire how far, and in what way, it might be desirable to find increased space for the Museum collections.

Report opposed to separation.

Their report was adverse to the decision of the general meeting of the Trustees of the 21st of January, distinctly stating their conclusion "that sufficient reason has not been assigned for the removal of any part of the valuable collections now in the Museum, except that of Ethnography and the portraits and drawings." They pointed out that the ground immediately surrounding the Museum, comprising about 5½ acres, and valued at about £240,000, belonged to a single owner, and gave as their opinion, "that it would be a convenient, and possibly even a profitable, arrangement for the State at once to purchase that interest, and to receive the rents of the lessees in return for the capital invested;" and they urged that if this suggestion were disregarded, "to avoid greater ultimate expense through alterations and rearrangements, sufficient space should be immediately acquired in connection with the British Museum to meet the requirements of the several departments."

The Trustees had no other course than to refer to the Government the final determination of the question, and in November, 1861, they received intimation from the Lords of the Treasury that they were prepared to take steps for removing a portion of the National collections to South Kensington, and the Trustees were asked to give further advice in respect to this proposal. Their recommendation was that the whole of the Natural History collections should be simultaneously removed, as well as also those of Ethnography. Accordingly, a Bill was brought in by the Government early in the session of 1862, to enable the Trustees to effect this removal; but it was rejected, on the ground of the great outlay required for the erection of the proposed new building at South Kensington. Much public discussion ensued on this defeat of the intentions of the Government; Professor Owen setting forth his views in a work entitled, "On the Extent and Aims of a National Museum of Natural History," published in the summer of 1862. In the session of 1863, the Government renewed their efforts to cope with the Museum difficulty, and after failing to induce the House of Commons to sanction the purchase of the entire Exhibition buildings at South Kensington, with the view to appropriating a portion of them to the purposes of a Museum of Natural History, succeeded in obtaining a vote for the purchase of the requisite number of acres from the Exhibition ground. The prospect of the immediate erection of the desired building seemed now sufficiently promising, but nearly twenty years were to elapse before its complete realisation. Plans for the proposed Museum had already been prepared for Government. In September, 1862, Mr. Hunt, of the Office of Works, was instructed to work out the design of a building suggested by Professor Owen, and this was submitted to the House of Commons in June, 1863. The proposed building was to have covered about four acres of land; would have consisted of a vaulted basement, two storeys above the roadway for the exhibition of the collections, with an attic over a part of the centre for libraries and professors' rooms, and would have included a theatre, 100 feet in diameter, for lectures. The site was to be on the east side of Queen's Gate, and the cost of the building was estimated at £350,000. The land was purchased at the rate of £10,000 per acre.

Government plans.

Professor Owen's pamphlet.

Purchase of land at South Kensington.

Plan of building on Professor Owen's scheme.

Plan by Capt. Fowke for utilising Exhibition building.

In connexion with the Government scheme for utilising a portion of the Exhibition buildings at Kensington Gore, a plan had been prepared by Captain Fowke, assisted by Mr. Hunt, for completing and rendering them permanently substantial. The plan gave "a decorated building in Portland stone," of the French Renaissance style of architecture, and occupied a site measuring 1,150 ft. by 738 ft. The cost was estimated at £469,000, or rather less than 3d. per cubic foot. It was printed as a Return to an Order of the House of Commons of the 19th of June, 1863. A principal portion of this building was to be appropriated to the purposes of the desired Natural History Museum.

Competition designs.

In January, 1864, the Commissioners of Her Majesty's Works issued an advertisement for designs for a Natural History Museum and a Patent Museum, to be erected on part of the site of the International Exhibition at South Kensington, the designs to be delivered at the Office of Works on the 30th of March. The extent of ground was the same as that in Captain Fowke's plan; and the plan prepared by Mr. Hunt, in September, 1862, from Professor Owen's suggestions, was proposed as a model in respect to dimension and internal arrangement.

Capt. Fowke's plan.

The plans of the various competitors were submitted to H.M. Commissioners of Works, who awarded prizes to three of the number, giving precedence to that of Captain Francis Fowke, R.E., and then referred the three premiated plans to the Trustees of the British Museum. The internal arrangements in Captain Fowke's plan were disapproved by the Museum officers, and he was desired to modify them in conformity with the requirements of the Trustees. He was engaged in this labour when his death occurred, in September, 1865.

His death.

Description of Capt. Fowke's plan.

Captain Fowke's design occupied the site from the Horticultural Gardens to Cromwell Road, and from Exhibition Road on the east to Queen's Gate on the west. It consisted of a main building, fronting Cromwell Road, and two detached wings, and was intended for both a Natural History Museum and a Museum of Patents, the wings being appropriated to the latter. The general style was that of the French Renaissance, and the material red brick, with white terracotta mouldings and strings, and red terracotta ornament: polished granite or marbles were to be introduced if desired.

It had a central cupola, and four surrounding smaller cupolas, and was flanked by two towers with belvedere storeys.

The main entrance was through a vestibule into a central hall under the cupola, where was placed the principal stair; and a theatre, or lecture-room, 100 feet in diameter, was approached from the hall.

From the centre of the building a suite of rooms extended longitudinally to the right and left; and from these opened, at right angles, the several Museum rooms, side by side. At each side of the hall were glass-covered courts, suitable for exhibiting larger isolated objects.

Early in the year 1866, Mr. Alfred Waterhouse was invited by the Chief Commissioner of Works to take up the unfinished work of Captain Fowke; but he found himself unable to complete the plan to his own satisfaction, and in February, 1868, he was commissioned to form a fresh design, embodying the requirements of the officers of the Natural History Departments of the Museum. Mr. A. Waterhouse engaged.

Mr. Waterhouse was not long in submitting to the Trustees his plan and model of a building, with a disposition of galleries as required, and these were formally accepted by the Trustees in April, 1868. It was not, however, until February, 1871, that the working plans had been thoroughly considered and had received the final approval of the Trustees. His plan accepted.

The actual work of erection was commenced in the year 1873, and the building was handed over to the Trustees of the British Museum by H.M. Commissioners of Works in the month of June, 1880. By the kindness of Mr. Waterhouse I am able to submit a description of the structure as written by himself:— Completion of building.

"The New Natural History Museum will, from its position, always be more or less identified with the International Exhibition of 1862, which occupied the whole of the site Description.

between the Horticultural Gardens and Cromwell Road. It was at one time thought that a portion, at any rate, of the Exhibition buildings could with advantage have been converted into a Museum of Natural History. Parliament, however, decided against the preservation of any part of these buildings, and they were accordingly entirely removed.

"In designing the present building, Captain Fowke's original idea of employing terracotta was always kept in view, though the blocks were reduced in size, so as to obviate, as far as possible, the objection to the employment of this material, arising from its liability to twist in burning. For this and other reasons the architect abandoned the idea of a Renaissance building, and fell back on the earlier Romanesque style which prevailed largely in Lombardy and the Rhineland from the tenth to the end of the twelfth century.

"In 1873 a contract was entered into by the Government with Messrs. George Baker and Sons of Lambeth for the erection of the building at a cost of £352,000. Other subsequent contracts have been entered into by the Treasury, especially one for the erection of the towers, which in the first instance it was decided to omit.

"On looking at the exterior of the building, one of the first points which strikes a spectator is that the site is lower than the street. This arises from the fact that the whole surface of the ground between the three roads was excavated for the Exhibition building of 1862, and it was not thought desirable, for economical considerations, to refill the space. The building is set back 100 feet from the Cromwell Road, and is approached by two inclined planes, curved on plan and supported by arches, forming carriage-ways. Between the two are broad flights of Craigleith stone steps, for the use of those approaching the building on foot. The extreme length of the front is 675 feet, and the height of the towers is 192 feet.

"The return fronts east and west beyond: the end pavilions have not been erected.

"On entering the main portal, the visitor has before him the great central apartment of the Museum (170 feet long × 97 feet wide and 72 feet high), which it is intended to use as an Index or Typical Museum. The double arch in the immediate foreground which spans the nave (57 feet wide), carries the staircase from the first to the second floor. Opposite the spectator, at the end of the hall, is the first flight of the staircase, 20 feet wide, which rises from the ground to the first floor. The galleries over the side recesses form the connexion between the two staircases, and are also intended for exhibition space, as are also the floor of the main hall and the side recesses under the galleries. The arches under the side flights of the main staircase at the end of the hall lead into another large apartment, cruciform on plan, intended for the exhibition of illustrations of British Natural History, with an extreme length of 97 × 77, measured into the arms of the cross.

"Branching out of the Index Museum, near its southern extremity, are two long galleries, each 278 feet 6 in. long by 50 feet wide. These galleries are repeated on the first floor, and in a modified form on the second floor. They are divided into bays by coupled piers arranged in two rows down the length of the galleries, and planned in such a manner as to allow of upright cases being placed back to back between the piers and the outer walls, so as to get the best possible light upon the objects displayed in the cases with the least amount of reflection from the glass, and leaving the central space free as a passage. Owing to the nature of the specimens exhibited in one or two of these galleries requiring for their exhibition rather table-cases than wall-cases, advantage has only been taken to a limited extent of this disposition of the plan. These terracotta piers, however, are constructively necessary, not only to conceal the iron supports for the floor above, but to prevent these supports being affected in case of fire. Behind these galleries on the ground floor are a series of top-lighted galleries, devoted, on the east side, to Geology and Palæontology, and on the west to Zoology.

"The towers on the north of the building have each a central smoke-shaft from the heating apparatus, the boilers of which are placed in the basement, immediately between the towers, while the space surrounding the smoke-shafts is used for drawing off the vitiated air from the various galleries contiguous thereto. The front galleries are ventilated into the front towers, which form the crowning feature of the main front. These towers also contain, above the second floor, various rooms for the work of the different heads of departments, and on the topmost storey large cisterns for the purpose of always having at hand a considerable storage of water in case of fire. On the western side of the building, where it is intended that the Zoological collection shall be placed, the ornamentation of the terracotta (which will be found very varied both within and without the building) has been based exclusively on living organisms. On the east side, where Geology and Palæontology will find a home, the terracotta ornamentation has been derived from extinct fossiliferous specimens.

"The Museum is the largest, if not, indeed, the only, modern building in which terracotta has been exclusively used for external façades and interior wall-surfaces, including all the varied decoration which this involves."

Delay from want of Exhibition cases.

One of the consequences of the scheme of transferring the Natural History collections to a new repository has been the necessity of providing to a great extent new cases for exhibiting the specimens. It was not possible to adapt the old wall-cases to the galleries of a differently constructed building; and the increased space required an addition to their number. The great cost of these cases has been a cause of delay in moving the collections.

The Zoological department will follow those of Geology, Mineralogy and Botany in their migration to the new quarters provided for them in the early part of the coming year. The other three departments have arranged their collections in their respective galleries.

Three departments at present removed.

The Keeper of Geology has now for the first time suitable means of exhibiting his collections. In the building at Bloomsbury the exhibition space was limited to three entire rooms and the walls of four others leading from them; a large proportion of the specimens being stored away in cabinets forming the pedestals of the showcases for minerals.

The history of the formation of the Geological Collection goes back to the date of acquisition of Sir Hans Sloane's Museum, the year 1753; the geological portion of which was found to consist "in what, by way of distinction, are called *extraneous fossils*, comprehending petrified bodies, as Trees, or parts of them; Herbaceous Plants; Animal Substances. . ." The collection was reported to be "the most extensive and most curious that ever was seen of that kind." It received but slight additions in the earlier years of the Museum's progress, but, under the influence of the extreme interest taken in the science of geology, has now attained a truly noble expansion. Until the year 1857 the Geological collections were united with those of Mineralogy under the charge of one keeper, but in that year Mineralogy was separated and constituted into a distinct department. Among the contents of the Geological department are upwards of fifty collections of Fossils having the original specimens named, described, and figured in various works on Palæontology, and on this account termed "type specimens." Of these the most worthy of note are Dr. William Smith's collection, illustrative of his work, "Strata identified by Organized Fossils" (London 1816–19); Mr. Thomas Hawkins' collection of Reptiles, from the Lias, figured and described in his work "Sea-Dragons," forming two great groups, the Ichthyosauri and the Plesiosauri; a very extensive series of Mammalian remains from the Sewalik Hills, described by Falconer and Cautley in their "Fauna Antiqua Sivalensis"; Koch's collection of remains of the Mastodon Ohioticus, from Missouri, U.S.; the Bravard collection of South American remains of Mammalia; the Bain collection of South African Reptilian remains; the Gilbertson collection of Carboniferous Limestone Fossils, figured by Phillips in his Geology of Yorkshire; the Bowerbank fossils; the Marchioness of Hastings' collection from Hordwell, Hampshire; the Edwards collection of Eocene Tertiary Mollusca, containing the types of his Monograph; Sir Antonio Brady's series of Mammalian remains from Ilford, Essex; the Van Breda Museum, comprising specimens from the Maestricht chalk, and from all parts of Europe, rich in figured specimens, and the Tesson collection of Oolitic Fossils, from Normandy; Dr. Ettings-

Formation of Geological collection.

hausen's collection of Fossil Plants of Austria; the Beccles collection of Mammalian and Reptilian remains from the Purbeck beds of Swanage; Dr. Häberlein's Solenhofen collection; and J. de Carle Sowerby's collection, containing most of the specimens figured in his "Mineral Conchology."

The last acquisitions of importance in this department are the celebrated collections of Fossil Fishes formed simultaneously by the Earl of Enniskillen and the late Sir Philip Grey-Egerton, Bart., M.P., which were used by Professor Agassiz in his works on Fossil Fishes. They contain most of the types figured and described by that author.

Formation of Mineralogical collections.

The original nucleus of the Mineral collection was formed by the purchase, in 1811, of Col. Greville's minerals, among which were a magnificent crystalline specimen of Rubellite from Ava, and some of the finest specimens known of the rare minerals Phosgenite and Matlockite. The great development of the collection since the institution of the Mineralogical, as distinct from the Geological, Department, in 1857, has been effected by the acquisition of certain important collections and by purchases of individual specimens, as far as possible directly from the districts in which the minerals were raised. Of the acquisitions since 1857, the most important is the Allan-Greg collection, first formed by Mr. Allan, of Edinburgh, added to by its subsequent owner, Mr. Robert Greg, and purchased by the Trustees in 1859. It supplied many species previously wanting to the collection, and was especially valuable for the authenticity of the localities assigned to the specimens; in which respect the Museum collection had fallen much in arrear. It also gave a new starting point for the collection of Meteorites by the addition of a carefully formed series of these bodies. The Meteorites, now representing 361 distinct falls, form the most complete collection that exists. The Mineral Department received a very important addition in the year 1865, when the collection formed by the eminent Russian crystallographer and mineralogist General von Kokscharow was purchased in St. Petersburg. By this purchase a very fine series of Russian and Siberian minerals was acquired, including Topazes from the Urulga River and Siberian specimens of Euclase of the greatest rarity. Among the most remarkable donations to the department are a unique crystalline mass of Rubellite from Ava, presented by the late Col. Guthrie, and a magnificent mass of crystals of Proustite (light red silver ore) presented by Mr. H. Ludlam, F.G.S., in 1877.

Formation of Botanical collections.

The oldest collections in the Botanical Department are: the Herbarium of Sir Hans Sloane, which contains—the plants collected by him in Jamaica, and figured and described in his Natural History of that island; the plants collected in Japan by Kaempfer; in Malabar and the Philippines by Camell; in Carolina by Catesby; the British collection of Adam Buddle; and the plants figured by Plukenet: a Herbarium of John Ray, presented, with the Herbaria of Rand and Nichols, by the Apothecaries' Company; and the plants collected in Ceylon by Hermann, and described by him and subsequently by Linnæus. The general Herbarium consists of that of Sir Joseph Banks, which includes the plants from Count Clifford's garden, representing the species described by Linnæus in his "Hortus Cliffortianus"; plants from Guiana collected by Aublet and Martin; the plants collected in the voyages of Capt. Cook; and authentic specimens from many of the botanists who lived in the end of the last and the beginning of the present century. These collections have been largely added to by the purchase or presentation of the plants of Ruiz and Pavon, Gardner, Bowie and Cunningham, R. Brown, Welwitsch and others, and of the general Herbaria of Miers, Shuttleworth and Auerswald, the Ferns of John Smith, the Mosses of W. Wilson, the Mosses and Hepaticæ of Hampe, and numerous other collections from various parts of the world. The British Herbarium contains the plants employed by Sowerby in the preparation of his work, "English Botany," the Herbarium of Edward Forster, and other collections.

Comparative space.

In the present building the means are afforded of making a display of specimens on a scale adequate to the purposes of comparison of species. The comparative exhibition floor-space in superficial feet for these three departments in the old building and the new, are:

OLD BUILDING.

		Sup. Feet.
Geology and Mineralogy . . .		16,560
Botany		5,004
Total .		21,564

NEW BUILDING.

Geology . . .	32,478	
Mineralogy . . .	13,920	
		46,398
Botany		13,920
Total .		60,318

The three departments have also ample provision of rooms for officers and students, signally deficient in the older building.

all and idex Mu-eum.

The great hall, in which the visitor finds himself on entering the Museum, has not yet its intended objects of exhibition. It is proposed to place in the centre skeletons of whales and other objects requiring extended space; and, in carrying out Professor Owen's design, to fill the surrounding bays with specimens from the different collections, selected to show the type-characters of the principal groups of organized beings. It is the purpose of Professor Owen to make this selection what he would call an "Index Museum," serving as an introduction to the study of the several collections, and made valuable by the addition of his own demonstrations of progress in the development of created forms.

EDWARD A. BOND.

BRITISH MUSEUM, *January* 1*st*, 1883.

LIST OF BENEFACTORS TO THE BRITISH MUSEUM (NATURAL HISTORY) FROM WHOM DONATIONS OF MAGNITUDE HAVE BEEN RECEIVED.

1753. SIR HANS SLOANE, BART.* (*By bequest.*)
Collections of Natural History.

1756–59. PITT AND SMART LETHIEULLIER, ESQS.
Specimens of Natural History.

1764. MATHEW DUANE, ESQ.
Minerals.

1766. HIS MAJESTY KING GEORGE III.
Natural Productions, collected by Edward Wortley Montagu, Esq.

1772–1878. THE ROYAL SOCIETY.
A large collection of Natural Curiosities.

1784. DR. PETER CAMPER.
Jaw of Gigantic Chalk Reptile, from Maestricht, Holland: *Mosasaurus Hoffmani*, Cuvier.

1784. CHARLES, 4TH DUKE OF RUTLAND, K.G.
Plesiosaurus rugosus (*Owen*), from the Lower Lias, Leicester.

1799. THE Reverend CLAYTON MORDAUNT CRACHERODE. (*By bequest.*)
Miscellaneous Minerals, &c.

1800. SIR WILLIAM HAMILTON, K.B., F.R.S.
A collection of the Volcanic Agglomerates of Monte Somma, and of Lavas from Vesuvius.

* Sir Hans Sloane may be acknowledged as a Benefactor and almost as a founder, because, although payment was made for the Sloane collection, the payment was intentionally fixed in amount considerably under the value.

1823. His Majesty King George IV.

A large collection of Minerals from the Hartz Mountains.

1825. Sir Gore Ouseley, Bart.

Specimens of Minerals.

1827. Sir Joseph Banks, Bart., P.R.S. (*By bequest.*)

His great Herbarium and collections of fruits, woods, &c.

1834–78. Sir Philip de Malpas Grey-Egerton, Bart., M.P., F.R.S.

Chalk Reptile (*Dolichosaurus longicollis*); an extensive series of Reptilian remains, including bones of *Pterodactyles* from Stonesfield.

1835. Major-General Thomas Hardwicke. (*By bequest.*)

A collection of Indian Animals.

1836. Sir Robert Hermann Schomburgk.

Plants, Fruits, and Woods of British Guiana, with illustrative Drawings; specimens of Beryl.

1836. Dr. Richard Simmons, F.R.S.

Specimens, almost unique, of the species Mimetesite, Idocrase, and Calamine.

1837–51. Spencer, 2nd Marquess of Northampton, P.R.S.

Apophyllite, Andreasberg, Hartz, and various other Minerals.

1837–78. Charles Darwin, Esq.

Frequent donations, including some of the collections made by him on his voyage in the "Beagle."

1838. Sir Woodbine Parish, F.R.S.

A large mass of Meteoric Iron, from Buenos Ayres.

1839–54. Captain Sir Everard Home, Bart., R.N.

Botanical collections from Australia, New Zealand, and the Pacific Islands.

1842–48. Colonel Sir Proby Thomas Cautley, K.C.B.; Dr. Hugh Falconer, F.R.S.; Colonel Baker, C.B.; Colonel Colvin.

Fossil Mammalian and other remains from the Sewalik Hills, India.

1844–81. William Garrow Lettsom, Esq.

Numerous specimens of Minerals.

1845. Captain Philip Parker King, R.N.

Plants collected during a voyage to South America, with illustrative drawings.

1847. Charles Frazer, Esq., *Bengal C.S.*

Nerbudda Valley Fossils.

1847. Mrs. Rudge.

The Herbarium of Edward Rudge, including the plants of M. Martin, collected in French Guiana.

1847–56. Sir George Grey, K.C.B.

South African Reptilian Fossils.

1847–80. George French Angas, Esq.

Frequent donations of the Shells described by him.

1850. Captain Kellet, R.N., and Lieut. Wood, R.N.

Mammalian remains from Kotzebue Sound.

1850. Mrs. Stanley.

Collection made by Captain Owen Stanley in the voyage of H.M.S. "Rattlesnake" in New Guinea, &c.

1850–72. Professor John Ruskin.

Numerous specimens of Minerals.

1851. Joseph Walter Tayler, Esq., F.G.S.

Various Greenland Minerals.

1852–60. Sir Roderick Impey Murchison, Bart., K.C.B.

Fossil Fox (*Galecynus Œningensis, Owen*), Miocene *Œningen;* and numerous other Fossils, from various localities. 1872. (*Executors*) A further collection of Fossils.

1853. ANDREW GEDDES BAIN, ESQ.
South African Reptilian Fossils.

1855. SIR JOSEPH DALTON HOOKER, K.C.S.I., C.B., F.R.S., and DR. THOMAS THOMSON.
A set of their "Plants of India."

1858. ROBERT BROWN, ESQ., D.C.L., F.R.S.
His collection of Preparations and Specimens of Fossil Woods.

1858. SIR WILLIAM DENISON, GOVERNOR OF MADRAS.
A large stone of the Aërolite which fell at Parnallee in 1857.

1858. THE TRUSTEES OF THE MUSEUM OF NATURAL HISTORY, SYDNEY.
Remains of *Diprotodon* and *Nototherium*.

1859. MISS WARNE.
Fossil Fishes from the Canton Glarus.

1860. THE ASIATIC SOCIETY OF BENGAL.
Numerous Meteorites.

1860. WILLIAM, 3RD EARL OF ENNISKILLEN, LL.D., F.R.S.
More than 100 *Pterodactylian* and *Saurian* remains, chiefly from the Great Oolite, Stonesfield.

1861. JAMES J. BERKLEY, ESQ.
A large series of Zeolites from the Doleritic Rocks of the Syhadree Mountains, Bombay.

1861–66. SIR DANIEL COOPER, BART.
Remains of *Diprotodon, Nototherium,* &c., from Gowrie, Queensland.

1861–72. HIS ROYAL HIGHNESS THE DUKE OF EDINBURGH, K.G., K.T.
Dicynodont remains from the Cape; and remains of *Nototherium* and *Dinornis,* from Australia and New Zealand.

1862. JAMES BRUCE, ESQ.
The Cranbourne Meteorite.

1862. THE WORSHIPFUL COMPANY OF APOTHECARIES.
An extensive series of Plants, including the Herbaria of John Ray, Dale, Rand, and Nichols.

1863–77. THE HONOURABLE ROBERT MARSHAM, F.G.S.
Oolitic Reptilian Remains; Chalk Fishes; Choice Oolitic Ammonites; Echinoderms and Mollusca; and various Minerals from numerous British and foreign localities.

1864–65. JAMES POWRIE, ESQ., F.G.S.
Numerous specimens of *Pterygotus*, and casts of *Stylonurus* from the Old Red Sandstone of Forfarshire.

1865. DAVID A. STODDART, ESQ.
Remains of *Mastodon, Toxodon, Mylodon, Megatherium*, and *Scelidotherium* from Rio Negro, Uruguay.

1865. EDWARD HILL, ESQ.
Remains of extinct Australian Marsupials.

1865–69, 1874. JOHN CLAVELL MANSEL-PLEYDELL, ESQ., F.G.S.
Numerous collections of Reptilian remains, &c., from the Kimmeridge Clay, Dorsetshire.

1865–73. SEARLES VALENTINE WOOD, ESQ., F.G.S.
Collections of the Fossil-Mollusca and Polyzoa of the Crag of Suffolk.

1866–79. HENRY LUDLAM, ESQ., F.G.S.
Group of Proustite, and various other Minerals.

1866–79. SIR WALTER CALVERLEY TREVELYAN, BART. (*By gift and bequest.*)
Fine Mineral Specimens from Faroe and other localities; Fossils; &c.

1867. CHARLES FALCONER, ESQ.
Fossil Mammalian remains.

1867–68. W. G. LETTSOM, ESQ.
Remains of *Megatherium americanum, Mylodon Lettsomi, Glyptodon, and Toxodon* from South America.

1868. Colonel E. R. Wood.

Figured specimens of *Rhinoceros hemitœchus*, *Canis*, *Ursus*, *Elephas antiquus* and Human remains from the Gower Caves, Glamorganshire.

1868. Professor Ansted, F.R.S., F.G.S.

Upper Jaw of *Rhinoceros etruscus* from Malaga.

1868. The Trustees of the Canterbury Museum.

The Figured Specimen of the lower Jaw of *Mastodon andium* from Chile.

1868. Sir Charles Lyell, Bart., F.R.S.

Numerous Tertiary and other Fossils; also remains of the gigantic extinct Beaver (*Trogontherium Cuvieri*), from the Norfolk Forest-Bed, Bacton; and Fossil Footprints from North America.

1869. Colonel Charles Seton H. Guthrie.

A large specimen of Rubellite, from Ava.

1869–80. Robert H. Scott, Esq., M.A., F.R.S., F.G.S.

A series of Tertiary Leaves from Greenland, described and figured by Dr. Oswald Heer.

1870. Hon. J. K. Howard.

Remains of *Rhinoceros tichorhinus*, *Equus fossilis*, *Bos primigenius*, *Hyæna spelæa*, *Elephas primigenius* and Reindeer from a Cave in Doward Wood, Herefordshire.

1871–72. Señor Luis J. Fontana.

A series of Fossil bones from the Alluvial Deposits of Buenos Ayres.

1871. Richard Daintree, Esq., F.G.S.

Remains of *Thylacoleo carnifex*, *Diprotodon*, *Nototherium*, *Macropus*, Bird and Saurian remains from Mary Vale, Queensland, &c.

1872. Sir Philip Duncombe.

Remains of Mammoth and Rhinoceros from Brickearth, Fenny Stratford, Bucks.

1872. H.R.H. the Duke of Edinburgh.

Remains of *Nototherium* and *Dinornis* from New Zealand.

1872. Dr. George Bennett, F.R.S.
Numerous collections of extinct Australian Marsupials.

1873. Rev. Robert Mac Donald.
Remains of *Bison priscus, Ovibos moschatus, Elephas primigenius* and of Horse from Canada.

1873. Benjamin Bright, Esq., M.D.
A large general collection of British and other Fossils.

1874. The Swindon Brick and Tile Company, Swindon.
A great Land-Reptile from the Kimmeridge Clay (*Omosaurus armatus,* Owen).

1874–78. Rear-Admiral Spratt, C.B., F.R.S.
Maltese Elephant remains; Type-specimens of "Pigmy Elephant" of Malta.

1875. The Reverend Richard Thomas Lowe. (*By bequest.*)
A moiety of his Herbarium of Madeiran plants.

1875–82. C. B. Clarke, Esq., M.A., F.R.S.
Botanical specimens from his Indian collection.

1876. John Joseph Bennett, Esq., F.R.S. (*By bequest.*)
The Study-set of Plants from the Australian Collections of Robert Brown.

1876. Mynheer R. D. M. Verbeek, Superintendent of the Dutch Geological Survey of Sumatra.
A large series of Tertiary Fossil Fishes and Mollusca from Sumatra, Figured and described in the Geol. Mag., 1875, 1876, and 1879.

1876. Professor George Busk, F.R.S., &c.
A collection of Mammalian remains from the Genista Cave, Gibraltar.

1876. Dr. W. G. Atherston, M.D., F.G.S.
The Figured skull of *Dicynodon leoniceps* and other Reptilian remains from the Permian of S. Africa.

1876–82. The Reverend M. J. Berkeley, M.A., F.R.S.
Botanical drawings.

1877–82. THE DIRECTOR OF THE ROYAL BOTANIC GARDEN AT KEW.
Botanical specimens.

1878. WILLIAM CHAPMAN HEWITSON, ESQ. *(By bequest.)*
Collection of Butterflies.

1879. JOHN MIERS, ESQ. *(By bequest.)*
Herbarium containing the types of his numerous botanical contributions.

1880. HENRY TRIMEN, ESQ., M.B.
Botanical specimens from Ceylon.

1881. J. W. MIERS, ESQ.
Botanical Works from his Father's Library.

1881. HARRY BOLUS, ESQ., F.L.S.
Plants from South Africa.

1881. THE RT. HON. THE EARL OF DUCIE, F.R.S., F.G.S.
A large series of Chalk Fossils from Kent.

1882. THE MISSES MAUND.
The original Drawings of Maund's "Botanic Garden."

1882. F. SEYMOUR HADEN, ESQ., F.R.C.S., &c., &c.
A fine entire head of *Ichthyosaurus* and other Reptilian and fish-remains from the Lias of Lyme Regis; &c.

1882. F. A. ECK, ESQ.
Part of the Meteorite of Mejillones, Atacama; various minerals from Copiapo, Chili.

BRITISH MUSEU

Plan of the

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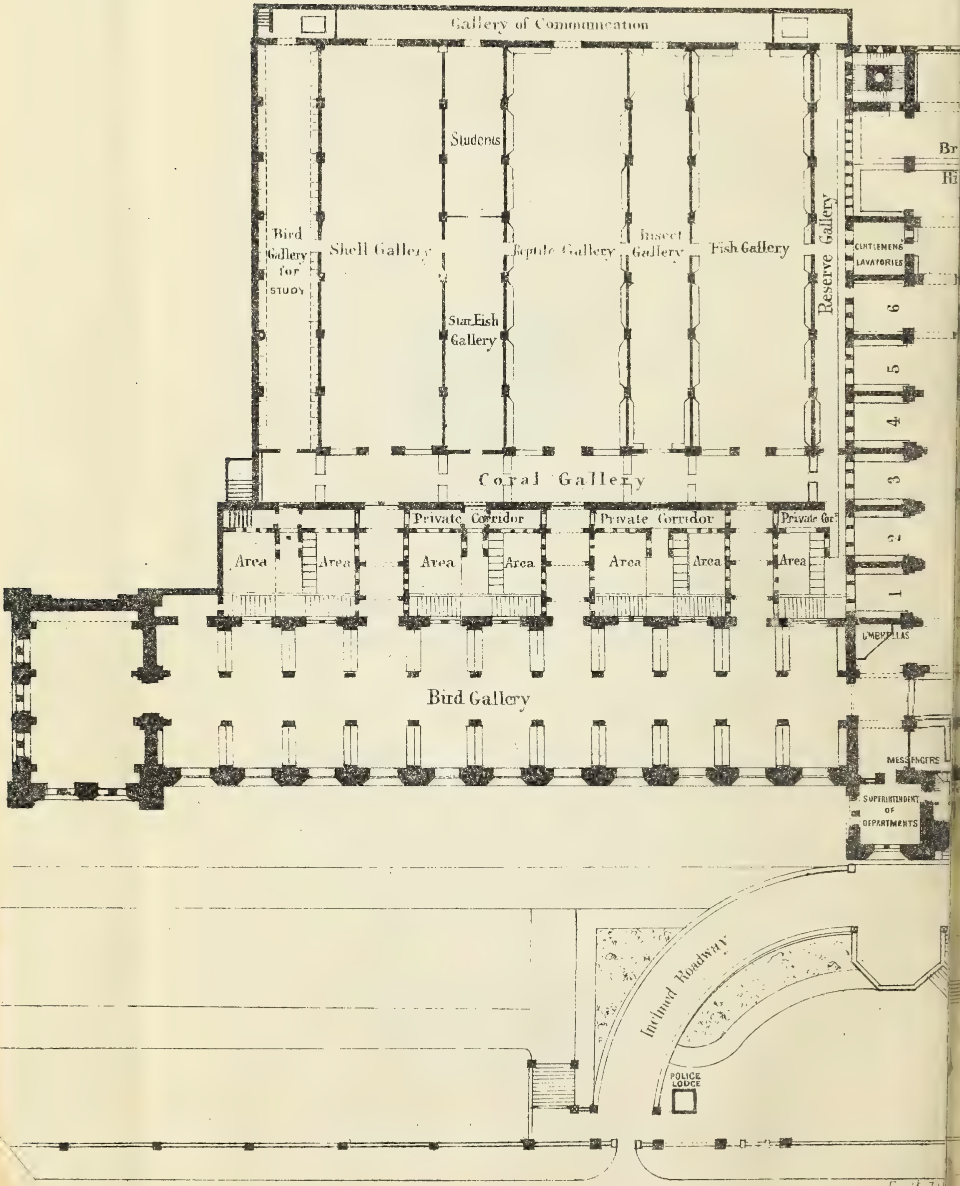

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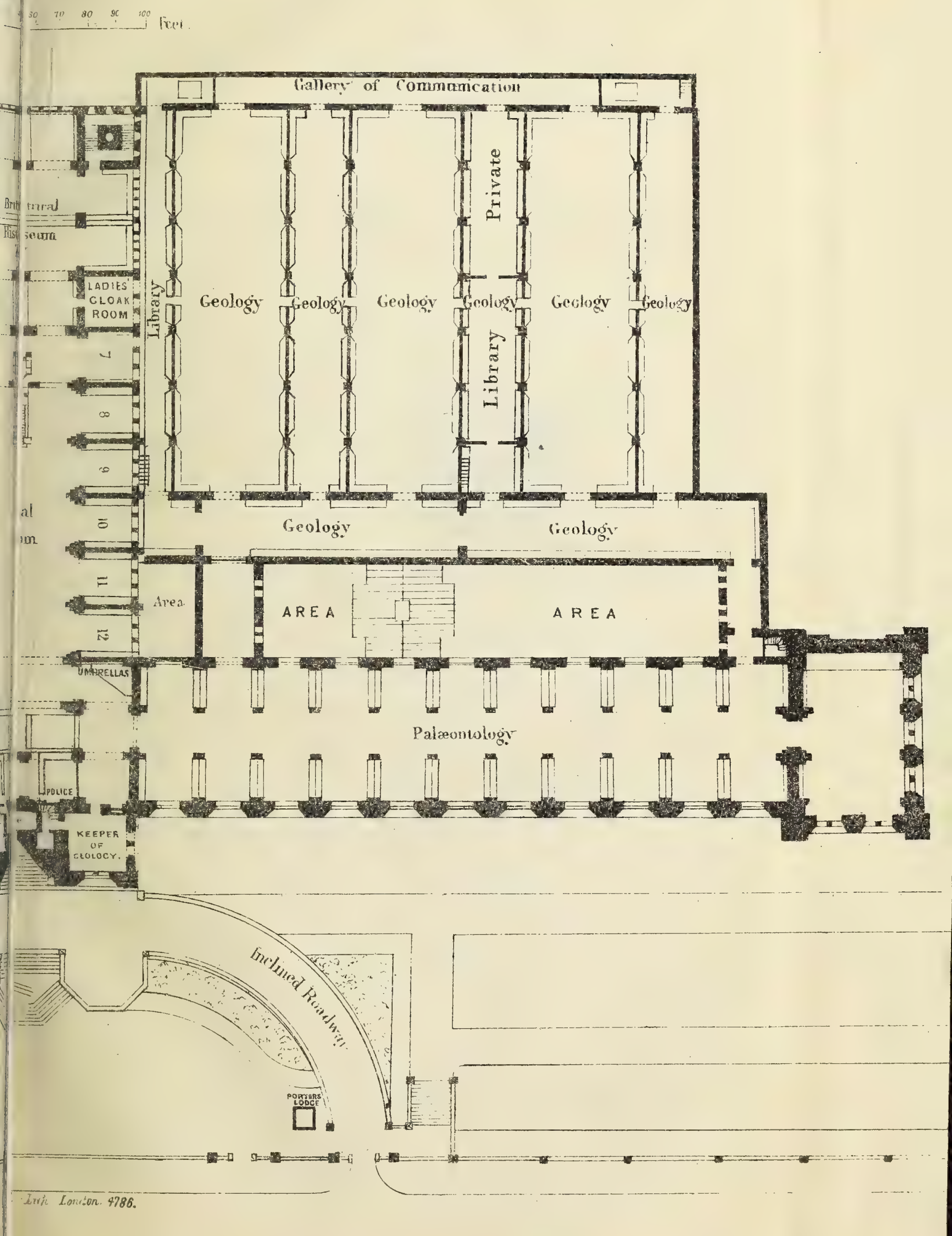

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DEPARTMENT

OF

GEOLOGY AND PALÆONTOLOGY.

EVERY intelligent person must desire to know something of "the ground beneath us,"—what, for instance, is the nature of the layers of chalk and limestone, coal, sandstone, clay, or slate, which occur in the various districts of our own Island, giving to each its special features of mountain, hill or valley, plateau or plain, forest, meadow, moorland, or moss; what is their origin, and, how came they to be formed as we see them to-day. To seek out the answers to these and many other kindred questions forms the province of the Geologist.

At one time Geology and Mineralogy were associated together as one science, and rocks were only classified according to their physical characters and composition; but at the end of the last century an intelligent land surveyor, named WILLIAM SMITH, discovered that the several strata composing the earth's crust might be identified all over the country by means of the fossils they contained, and that certain organisms were more or less peculiar to each. Filled with this idea, he travelled on foot through every county in England and Wales, and in 1815 he published his large Geological map, and also a work entitled "Strata identified by Organised Fossils," illustrated by fossils collected by himself. This collection of fossils, made by William Smith, is still preserved in the British Museum. From this time a new branch of study connected with Geology arose, called *Palæontology*, or the study of the ancient life-forms, whose remains lie buried as petrifactions in the rocks composing the crust of the earth. This science of Palæontology has become so very important to the

Geologist that he no longer relies entirely on the Mineralogist in the study of rocks,* but is able to determine the age and position of any particular stratified rock by a careful examination of its fossils. Thus Mineralogy has of late become almost a separate science, which treats of the chemical composition, optical and other properties of rocks, minerals, metals and precious stones; whilst Geology investigates the origin, relation, and distribution of the strata,—especially the sedimentary formations,—the changes which our earth has undergone in past times, as regards the distribution of land and sea, and the vicissitudes of climate, evidenced by the old faunas and floras of the globe which have successively lived, flourished, and died on old land-surfaces, or in the lakes, rivers, and seas of the past, the fossil remains of which fill the cases in our Geological Galleries.

Palæontology has thus largely replaced Mineralogy as "the handmaid of Geology;" and, although the microscopic study of rocks (in which the sister science Mineralogy comes to the aid of the Geologist) has of late attracted a large share of attention and elicited much valuable information, yet, without doubt, the investigation of the organic remains, which the sedimentary rocks have revealed to us, will always prove more attractive to the great majority of students. Just as the Antiquary, who rescues some old mosaic pavement whose myriad *tesseræ* have become ruptured and displaced by long interment in the earth, strives to unite its precious fragments and restore its pristine design for our admiration, so also the Palæontologist seeks from the fragmentary remains of a former world to rehabilitate the old animals, and show us, by the aid of comparative anatomy, what were the beings that once peopled our earth in past ages before Man had left any record of his existence.

So many good books on Geology have been published that it is not necessary to give in a Guide-book like the present a treatise on the science, but merely to explain that the specimens in the Geological Galleries are arranged according to

* We must still depend on the Mineralogist and Chemist for the correct determination of the igneous and metamorphic rocks, in which no traces of fossil organisms occur.

their zoological classes, orders, and families (so far as their true position can be ascertained), and under each are placed its name, geological position, and the locality whence it was derived, each class being grouped chronologically in descending order from the newest stratum to the very oldest. As only a part of the galleries are at present open, and these are not wholly arranged, visitors must not be surprised to find that many series of Fossil Organisms cannot at present be seen. It should, however, be borne in mind, that the collection is so large, and the removal from its old home has so recently been effected, that some time must necessarily elapse before the whole can be arranged.

All the Fossil Vertebrata, comprising the Mammalia, Birds, Reptiles, Amphibia, and Fishes, are exhibited. The Cephalopoda and the rest of the Mollusca, with the Crustacea and Echinodermata, can now be seen in Gallery B; whilst the Corals, Sponges, Foraminifera, and Plants, will soon be exhibited in Gallery C. Lastly, a Stratigraphical series of Rocks and Fossils is in preparation; but the staff attached to the Department being very limited, it cannot speedily accomplish so large a task.

The plan facing page 72, will serve to show the general arrangement of the collections; and those who knew the old galleries, where the Departments of Geology and Mineralogy were combined, will be able to form an idea of the vastly increased exhibition space which the new building affords.

The small Table of Strata, page 26, is given to show the range in time of the great groups of Mammalia, Birds, Reptiles, Amphibia, and Fishes.

Explanatory labels and other means have been adopted to bring the objects exhibited within the comprehension of all visitors.

TABLE OF STRATIFIED ROCKS.

Periods	Systems.	Formations.	Life-Periods.
QUATERNARY.	Post-Tertiary or Pleistocene. (250 ft.)	Peat, Cave and Valley-Gravel Deposits. Brick-earths and Loess. Raised Beaches, &c. Boulder-Clay and Gravels.	Dominant type, Man.
TERTIARY or CAINOZOIC.	Pliocene (100 ft.)	Norwich, Red, and Coralline Crags.	Dominant types, Birds and Mammals.
	Miocene (125 ft.)	Bovey Beds (?).	
	Eocene (2,600 ft.)	Fluvio-Marine Series. Bagshot Beds. London Tertiaries.	
SECONDARY or MESOZOIC.	Cretaceous. (7,000 ft.)	Maestricht Beds. Chalk. Upper Greensand. Gault. Neocomian. Wealden.	Dominant type, Reptilia.
	Jurassic. (3,000 ft.)	Purbeck Beds. Portland Beds. Kimmeridge Clay. Coral Rag. Oxford Clay. Great Oolite. Inferior Oolite. Lias.	
	Triassic. (3,000 ft.)	Rhætic. Keuper. Muschelkalk. Bunter.	
PRIMARY or PALÆOZOIC.	Permian. (500 to 3,000 ft.)	Red Sandstone, Marl, Magnesian Limestone, &c.	Dominant type, Fishes.
	Carboniferous. (12,000 ft.)	Coal Measures. Carboniferous Limestone.	
	Devonian. (5,000 to 10,000 ft.)	Devonian. Old Red Sandstone.	
	Silurian. (3,000 to 20,000 ft.)	Upper Silurian. Lower Silurian.	Dominant type, Invertebrata.
	Cambrian. 20,000 to 30,000 ft.)	Cambrian.	
	Laurentian, &c. (30,000 ft.)	Laurentian.	

Range of Invertebrata and Plants in time.
Range of Fossil Fishes in time.
Range of Fossil Reptilia in time.
Footprints of Birds ?
Range of Fossil Birds in time.
Range of Fossil Mammals in time.

SOUTH-EAST GALLERY.

Vertebrate Animals.*

CLASS 1.—MAMMALIA.

The Cases in the South-East Gallery are devoted to the exhibition of the Fossil remains of Animals of the class Mammalia,† the great proportion of which are only met with in the newer Tertiary and Quaternary deposits, forming the most superficial part of the earth's crust. The earlier traces of such higher class of animals are extremely rare, being met with in those rocks known to geologists as the Eocene formation;—a very few remains of almost the lowest class—the Marsupialia—extremely small in size, occurring in rocks of Secondary age.‡ (*See* Table-case No. 15 in the Pavilion.)

Many of these animals are quite extinct, but a very large number belong to forms closely related to the existing terrestrial orders—such as the cat-tribe (lion and tiger), the dog, the wolf, the seal, the bear, and hyæna; the rhinoceros, hippopotamus, pig, horse, camel, giraffe, elephant, deer, oxen, sheep; the beaver, marmot, hare, whales, &c.

The deposits which have yielded the largest proportion of these remains are met with in caves and fissures in limestone rocks, old lake and river valley-basins, filled up with gravels, sands, loess, and brick-earth; clays, shell-marls, and peat-deposits; ancient forest-beds, which have been covered up and submerged; and delta deposits formed in the estuaries of great rivers, such as the Thames, the Severn, the Rhine, the Nile, the Ganges, the Mississippi, the Amazons, and La Plata. The frozen soil of the great alluvial plains bordering the Arctic sea both in the Old and New World are rich in remains of large herbivorous animals, such as the "Mammoth" and the "Woolly Rhinoceros," that once inhabited these high northern latitudes before the climate became too cold for the growth of forest-trees.

All over the world caves are to be met with in limestone rocks. Examples of the animal remains found in some of these may be seen in Wall-case No. 1 and Table-case No. 1 (South side). As these caves have frequently served in prehistoric times as habitations for Primitive Man, when he subsisted by hunting and fishing, we

* In this great division of the Animal Kingdom is included all animals which possess a backbone.

† Animals that suckle their young; in this class is included man, and all the higher animals.

‡ *Microlestes Moorei*, Owen (represented by teeth only), from the Rhætic beds of Somerset, and *M. antiquus* from the Trias of Germany. *Dromatherium*, from North America. Other species (small but more numerous), from the Stonesfield and Purbeck beds of England and America.

D

not infrequently meet with evidence of human occupation, as the charcoal and ashes of fires,—the burnt and broken fragments of the bones of animals upon which he subsisted,—the rude implements of stone and bone which served as his weapons in the chase, or for domestic purposes, and even — but more rarely — rudely incised figures of the animals he saw and hunted, or the cherished ornaments of shell or bone which he had laboured to make for the decoration of his person.

It often happens that the same cave has served at different periods as a refuge for man and for various wild beasts—such, for instance, as the cave-lion, bear, or hyæna. Examples of remains of these animals, and of the gnawed bones of their prey, may be seen from Brixham, and Kent's Cavern, near Torquay; Kirkdale, Yorkshire; Gower, Glamorganshire; and other caves in England; from Bruniquel and Dordogne in France; from Gailenreuth, &c., in Franconia; and from Minas Geraes, Brazil.

ORDER I.—BIMANA.

Man.—In the first Table-case are placed various human remains from Kent's Cavern, from the Gower Caves, from a turbary, near Lewes; from Bruniquel, in France; from Mulhausen; from Brazil; casts of the Engis and Neanderthal skulls; also examples of the barbed harpoons made of reindeer-antler; bone needles; worked horns and bones; carved objects, and incised representations of animals from Neschers, from Bruniquel, and from the cavern of Les Eyzies, Dordogne; together with numerous stone implements from various localities, illustrative of Prehistoric Man.

In an upright Wall-case (A), near Table-case 1a, is placed the Fossil Human Skeleton brought from Guadaloupe, in the West Indies, by Sir Alexander Cochrane, R.N., and presented to the Museum by the Lords Commissioners of the Admiralty. Human skeletons are found in the island of Guadaloupe in the solid limestone rock which occurs on the sea-shore at the base of the cliffs, and which is more or less covered by the sea at high-water. This limestone rock, which is of modern formation, is composed of sand, the detritus of shells and corals of species still inhabiting the adjacent sea; it also contains some species of land-shells identical with those now living on the island. Accompanying the skeletons are found arrow-heads, fragments of rude pottery, and other articles of human workmanship.

ORDER II.—QUADRUMANA.

Monkeys.—The remains of the Quadrumana (four-handed animals), including at the present day the "Aye-Aye," and Lemurs, from Madagascar, and the various families of the monkey tribe (the

"Catarhine,"* or Old-World Monkeys, and the "Platyrhine,"† or New-World Monkeys), are very rarely met with in any part of the globe in a fossil state.

The earliest trace of Old-World Monkeys (Catarhina) are found in the Miocene Tertiary formations of France and Italy. Of these the fossil genus *Pliopithecus*, is related to *Semnopithecus* and to the man-like or anthropoid apes, but its precise position is uncertain. *Dryopithecus* occurs in the Upper Miocene of St. Gaudens, France, &c. *Hylobates*, found in the Miocene Tertiary beds of Epplesheim, was an anthropoid ape, of large size, with prominent pointed canine teeth, related to the Gibbons.

The *Oreopithecus* occurs fossil in Italy, and the *Mesopithecus* described by Prof. Gaudry at Pikermi, near Athens. The *Palæopithecus*, *Semnopithecus*, and *Macacus* are found fossil in the Sewalik Hills of India; the latter is also found in the Pliocene of Italy, and the *Cercopithecus* in the Pliocene of France. In Table-case No. 1 are also remains of a species of *Cebus* and of *Mycetes ursinus* from the caverns of Minas Geraes, Brazil.

ORDER III.—INSECTIVORA (Moles, Shrew-Mice, Hedgehogs).

This order comprises a number of small insect-eating mammals, similar in many respects to the Rodentia; but the molar teeth are always serrated with numerous small pointed eminences or cusps adapted for crushing insects. Remains of several of these little animals are found fossil in the Miocene deposits of Europe; at Grays, Essex; the Norfolk Forest-bed; &c. (*See* Table-case No. 1a.)

ORDER IV.—CHEIROPTERA (Bats).

The Bats are characterized by having the fingers of the fore-limbs enormously elongated and united by an expanded membrane, which also unites the fore with the hind-limbs and the sides of the body. Some of the large tropical bats are fruit-eaters; the others are insectivorous in their diet. They are found fossil in the gypsum-quarries of Montmartre (Upper Eocene), Paris, the species being named *Vespertilio Parisiensis;* others are found at Sansan and Mayence. The Vampire bat (*Phyllostoma*) is found fossil in the caves of Brazil; and *Nyctilestes* and *Nyctitherium* in the Middle Eocene deposits of North America. The *Rhinolophus* is found in Kent's Hole, Torquay. (*See* Table-case No. 1a.)

* From Greek: *kata*, downwards; *rhines*, nostrils; because they have the nostrils opening downwards, as in man.

† From Greek: *platus*, broad; *rhines*, nostrils; because the nostrils open on the surface of the face, the nasal bones being inconspicuous in size.

ORDER V.—RODENTIA (Gnawing Animals).

The Rodents (Table-case No. 24, North side), represented by the Hares, Rabbits, Porcupines, Beavers, Rats, Mice, Dormice, Squirrels, and Marmots—are characterized by having two curved chisel-shaped incisors, or cutting, teeth in each jaw, widely separated from the molar or grinding teeth.

There are usually two or three incisor teeth in the upper and two in the lower jaw (but sometimes there are four upper incisors). These animals have no canine teeth, but they generally have four molars on each side, above and below.

The oldest Rodent known is found fossil in the Eocene Tertiary formation; but such animals abound at the present day. Remains of the hare (*Lepus*) are found fossil in both N. and S. America, and also in Europe. The *Lagomys*, or tailless hare, and the Marmot (*Spermophilus*), characterize some of the Post-Glacial deposits in Britain. The latter occurs at Erith in the Thames Valley.

The Beaver is not only widely-spread at present, but its fossil remains prove it to have had an equally wide distribution in the past. It was once abundant in this country, as, for instance, in the valley of the Lea, near London, and in the Cambridgeshire fens. It is still found living in some of the rivers of Russia, and also in those of North America. A far larger species of beaver, called *Trogontherium*, once inhabited Norfolk, where its remains have been found in the Cromer forest-bed. A still more gigantic form, the *Castoroides Ohioensis*, is represented by a cast of the skull and lower jaw, from the Post-Tertiary of North America. A gigantic dormouse (*Myoxus melitensis*) has been found in the Post-Pliocene of Malta.

Near Table-case 24, in Wall-case No. 23, are placed the skull and lower jaw and some limb-bones of a colossal rodent-like animal, named *Toxodon*, probably larger than a horse, but having true Rodent teeth in its jaws. This remarkable fossil was obtained from the Newer Tertiary deposits of Buenos Ayres, and, with another aberrant form of Rodent, also from S. America, named *Typotherium* (*see* Table-case No. 24), proves the enormous sizes to which some of these extinct gnawing animals must have attained.

ORDER VI.—CARNIVORA (Flesh-eating Animals).

In the second Table-case (South side) are the remains of a large number of carnivorous animals, chiefly from caves, representing the Hyæna and Wolf, both ancient denizens of this Island; with the Fox, Dog, Badger, Glutton, Otter, Weasel, and many other allied forms—mostly represented by skulls and lower jaws.

In Wall-case 1, and in Table-case 2, are placed the skulls, lower jaws, teeth, and bones of the "great sabre-toothed tiger" (*Machairodus latidens*), remarkable for the enormous development of its canine teeth, and also for its wide geographical distribution. Fossil remains of species of this "sabre-toothed tiger" have been met with in Kent's Cavern, Torquay, in the Norfolk Forest-bed, in the Miocene Tertiary deposits of Eppleshein in Germany, the Auvergne in France, the Val d'Arno in Italy, the Pampas deposits and the bone-caves of South America, and the Upper Miocene Freshwater limestones of the Sewalik Hills in India.

The *Machairodus* is now quite extinct.

Another extinct species, whose remains have also been obtained from the alluvial deposits of Buenos Ayres, is the *Arctoidotherium*, an animal nearly related to the bears. (*See* Wall-case 1.)

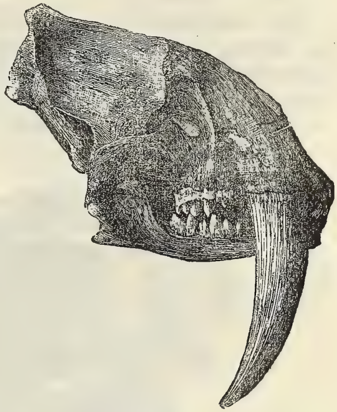


FIG. 2.—Skull of the "Great Sabre-toothed Tiger," *Machairodus;* from the Newer Tertiary deposits of South America.

Hyænodon, *Pterodon*, &c., from the Lower Tertiaries of France, are placed (temporarily) in Table-case No. 1A.

In a small Table-case (No. 2A) are placed the remains of the earliest representatives of the Carnivora, the *Amphicyon*, *Simocyon*, *Dinocyon*, and *Cynodictis*, together with other Miocene types; also remains of the Glutton, Badger, Otter, Marten, and Weasel. Here are placed a jaw of Walrus from the Dogger Bank, and remains of the Grizzly Bear (*Ursus ferox fossilis*), from Grays, Essex.

A fine series of remains of the Great Cave Bears fills the whole of Table-case No. 3. The caves of Sundwig, Rabenstein, Kuhloch, and Gailenreuth in Franconia, are well represented.

ORDER VII.—PROBOSCIDEA (ELEPHANTS).

The cases on the North side of this Gallery are nearly entirely devoted to the exhibition of a very large series of fossil remains of the order PROBOSCIDEA,* represented at the present day by the Elephant alone, and in past times by the Elephant, the *Mastodon*, and the *Dinotherium*. These animals have no *canine* teeth, and in this character they resemble the Rodentia (Rats and Rabbits); the molars or grinding teeth are few in number, but large, and marked by ridges or tubercles.

The teeth of the Elephant and Mastodon differ from those of other

* Animals furnished with a long flexible trunk-like snout or proboscis. The *Elephants* occupy Pier-cases 15 to 22, Wall-case 23, and Table-cases Nos. 17 to 23, and part of 24, on the *North side* of this Gallery.

orders of animals, by being developed from behind forwards, not from beneath the tooth in wear; and the series lasted until the animal attained extreme old age.

They had, when young, a pair of milk-tusks (or incisor teeth) in the upper jaw, and always one pair, and sometimes two pairs, of tusks were present in the adult animal (*see* Figs. 1 and 4). These tusks were provided with persistent pulp-cavities (analogous to the front teeth of the Rat and the Rabbit), which continued to grow as long as the animal lived. They had also three deciduous or milk-molars, and

FIG. 3.—Skull and lower Jaw of *Dinotherium giganteum* (Kaup), from the Miocene of Epplesheim, Hesse-Darmstadt.

[Marked (B) on plan, and placed near the entrance to Gallery on the left-hand side.]

one premolar, on each side, both in the upper and lower jaws, and three true molars in the adult, thus making a complement of thirty-four teeth during life. Some of the grinders of the Mammoth are of immense size, and have as many as twenty-eight or even thirty plates in a single tooth. (*See* Pier-case and Table-cases 17, 18, and 19.)

In living Elephants there are two incisors, called "tusks," in the upper jaw, but the lower jaw is without incisor teeth.

In the *Dinotherium*, an extinct species related to the Elephants.

FIG. 4.—Skull and lower Jaw of *Mastodon longirostris* (Kaup), showing tusks in both upper and lower Jaw, from the Upper Miocene, Epplesheim, Germany. (*See* Pier-case 21.)

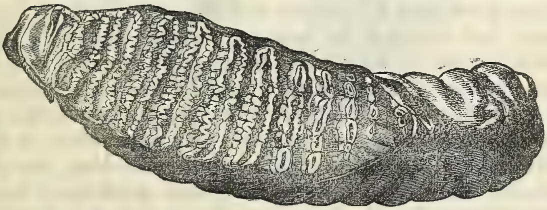


FIG. 5.—Upper Molar of living Indian Elephant.

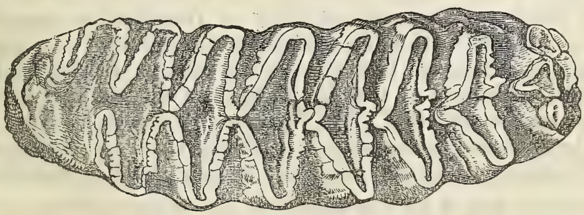


FIG. 6.—Upper Molar of living African Elephant.

this order is reversed, there being two tusk-like incisors in the *lower jaw*, and none in the upper.

In another extinct form, the *Mastodon* (*see* Fig. 1), the incisors are usually developed in the upper jaw, and form tusks as in the Elephants; but sometimes there are both upper and lower incisors, and both are tusk-like (*see* Fig. 4). All these animals had, like the living Elephants, a cylindrical trunk or proboscis (snout) with a prehensile extremity, serving to gather and convey the food to the mouth. The soles of the feet, supporting the weight of the body, are provided with a thick pad covered by the skin, and in this the five toes are enclosed and concealed in the living animal, but the nails of the toes can generally be seen.*

Only two living species of Elephants are known; one, the Asiatic Elephant, confined to India, Ceylon, &c.; the other, the African Elephant, peculiar to the continent of Africa. These are well-marked species, not only by their external characters, but also by their grinding teeth (*see* Figs. 5 and 6). These teeth in the Elephants are composed of strong enamelled plates encased in a thick setting of cement—the plates varying in number and in pattern in the different species. Thus the African Elephant has fewer plates of enamel in each tooth, and these on the grinding surface are worn down to a lozenge-shaped pattern (Fig. 6); the Indian Elephant having many plates, closely folded together and finely crimped at their edges (Fig. 5). The teeth of the larger number of fossil Elephants resemble those of existing species, but in some of the earlier forms they approach more nearly in character those of the *Mastodon*.

The Mastodons were Elephants with the grinding teeth less complex in structure, and adapted for bruising coarser vegetable substances. The grinding surface of the molars, instead of being cleft into numerous thin plates, was divided into wedge-shaped transverse ridges, and the summits of these were subdivided into smaller cones, more or less resembling the teats of a cow, whence the generic name is derived.

In Wall-case 23, on the left-hand side of the door, are placed the fossil remains of the *Dinotherium*, a hoofed quadruped, supposed to have been intermediate between the Tapir and the *Mastodon*, the most perfect remains of which have been found in the Miocene Tertiary formation of Epplesheim, Hesse-Darmstadt, Germany, while others have been found in France, Switzerland, and Perim Island, Gulf of Cambay. The original skull of *Dinotherium*, described by Dr. Kaup, together with a reproduction of the lower jaw, are placed on a separate stand (marked B on plan) in this gallery. (*See* p. 16, Fig. 3.)

The entire skeleton of the *Mastodon* from Ohio stands facing the entrance to the gallery. (*See* Vignette Title-page.) Near it are placed the head and lower jaw of the South-American *Mastodon* from Chile (*Mastodon Andium*†); and on another stand is exhibited the

* The external form of the feet can still be seen in the fossil Mammoth from Siberia, preserved at St. Petersburg.

† Marked (C) on plan and placed on the North side of this Gallery next Table-case 23.

cast of the skull of a young individual of *Mastodon ohioticus* from shell-marl beneath a peat-bog in the State of New Jersey, United States.

In Pier-case 22 are arranged fifteen heads and jaws, besides numerous detached limb-bones, and other parts of the skeleton of *Mastodon ohioticus* from North America. One fine lower jaw of this species has a small tusk in front.

Pier-case 21 is occupied with remains of *Mastodon arvernensis* from Epplesheim, *M. angustidens* from the Miocene of Sansan, and

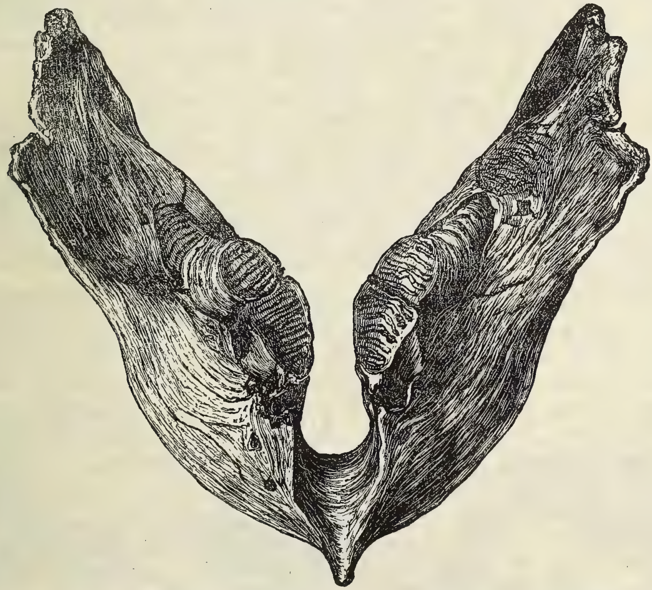


FIG. 7.—Lower Jaw of Mammoth, *Elephas primigenius.* Dredged off the Dogger Bank, in the North Sea, 1837.* (*See* Pier-case 16.)

M. tapiroides from Haute Garonne in France, and *M. Perimensis* from Perim Island, Gulf of Cambay. Of these there are some very perfect remains, including about eight heads. The specimens of *M. angustidens* and *M. longirostris* show clearly that this old type of proboscidean had tusks, or incisor teeth, in both the upper and lower jaws, as represented in Fig. 4, page 17.

In Table-case 23 are arranged a large series of the molar teeth of various species of *Mastodon* from the Red Crag of Suffolk, from Epplesheim, from India, and from Ohio in North America, showing all ages, from the milk-teeth to the last true molars of very aged animals.

* *See* Geol. Mag. 1878. Decade II. Vol. v. Pl. XII. p. 443.

The Mastodons, when living, had a range extending from England through France, Germany, Switzerland, Italy, to Armenia, India, and Ava; they have also been found both in North and South America. There are thirteen species of these old Elephants whose range was coextensive with that of the *Mastodon*, and embraced in addition the whole of Africa and the Northern seaboard of the Asiatic and North American continents.

Most abundant remains of one species, called the "Mammoth" (*Elephas primigenius*), have been found in the frozen soil of the vast alluvial plains called "tundras," intersected by the rivers Yenesei, Irtish, Obi, Indigirka, Lena, &c. In several instances, entire individuals have been found, so completely frozen, as to have retained the flesh and skin adhering to the skeleton; the body being covered with reddish wool and long black hair (an example of which may be seen in Pier-case 15), as if to protect it from the colder climate. The tusks of this Arctic Elephant are still collected for the sake of the ivory; and every few years a shipload is sent from Archangel to the port of London for sale. The Siberian Mammoth closely agrees with the specimens found fossil in various parts of England, especially at Ilford in the valley of the Thames near London, and on the coast of Norfolk.

Many of these remains may be seen in Wall-cases 15 and 16, and in the centre of the Gallery floor are placed the fine skull, tusks, and lower jaw of the Ilford Mammoth. Similar remains have also been found beneath modern London, associated with flint implements made by early man, with whom this old elephant was contemporary.

(Wall-cases Nos. 17 to 20.) India, the home of one of the two species of existing elephants, has also yielded abundant evidence of extinct species of this animal. The skull and tusks of *Elephas ganesa* (probably one of the largest of all the fossil elephants), from the Sewalik Hills in India, and exhibited next the Ilford specimen in the centre of the Gallery, has tusks which measure 10 feet 6 inches in length.* (Presented by General Sir William Erskine Baker, K.C.B.)

The late Dr. Falconer has described thirteen species of fossil elephants, nine of which are from India, and two occur fossil in this country.

Pier-case No. 17 contains some British remains of the *Elephas antiquus*; the rest of the case, and also of Pier-cases 18, 19, and 20, are entirely devoted to the great collection of elephant-remains from the Sewalik Hills (Upper Miocene) of India (figured and described in the *Fauna Antiqua Sivalensis*). This series includes more than thirty heads and parts of skulls of extinct species of elephants, besides numerous lower jaws, vertebræ, and limb-bones. For our magnificent series of skulls, tusks, and teeth of fossil Indian elephants, we are mainly indebted to the late Col. Sir Proby T. Cautley, K.C.B., so large a donor of specimens to the Geological Department.

* A mammoth's tusk from Eschscholtz's Bay, in the collection, measures 12 feet 6 inches along the curve. (*See* tops of Wall and Pier-cases, North side.)

Before quitting the fossil elephants, attention is drawn to Table-case 20, containing the truly remarkable series of *Pigmy Elephants* from the island of Malta, collected by Rear-Admiral Spratt, R.N., F.R.S., and the late Prof. A. Leith Adams, M.D., F.R.S. These Maltese elephants, which by the form of their grinders are related to the living African elephant (Fig. 6), were represented by one species, which only attained the size of a Shetland pony, and as we have evidence of their limb-bones, jaws, and teeth, of *all ages*—even to very old age—it is fair to assume they were a distinct race or variety, probably the result of isolation in a limited area where they may have suffered from a scanty supply of food, and so become dwarfed.

ORDER VIII.—UNGULATA (Hoofed Animals).

In Pier-cases Nos. 2 and 3 is arranged the series of remains of the fossil Rhinoceroses. These animals belong to the Order Ungulata, or "hoofed quadrupeds;" all of which are vegetable-feeders; and to the section which is named "uneven-toed" (*Perissodactyla*), because they all have *three toes* to the hind-feet. There is only a single living genus, which contains several species. The Rhinoceros is a huge herbivorous animal, with an extremely thick skin, marked by deep folds; there are seven upper and lower molar teeth on

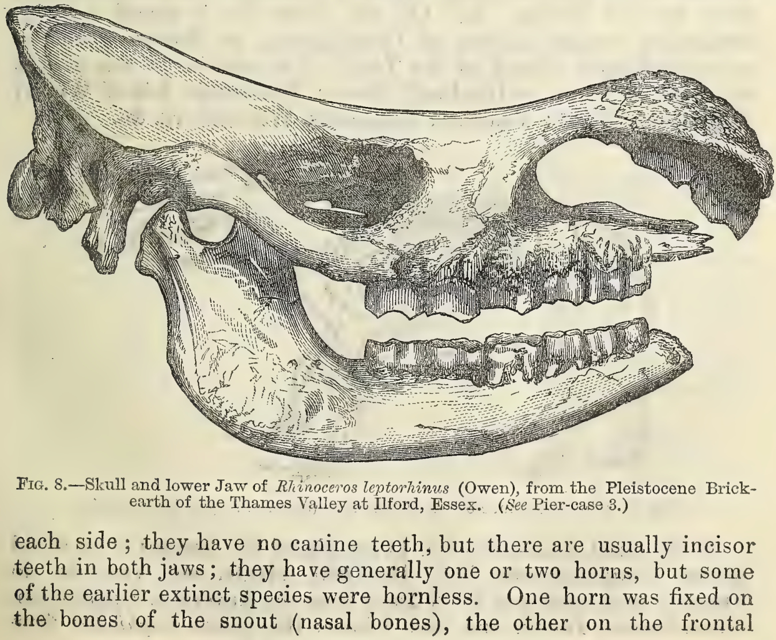


Fig. 8.—Skull and lower Jaw of *Rhinoceros leptorhinus* (Owen), from the Pleistocene Brick-earth of the Thames Valley at Ilford, Essex. (*See* Pier-case 3.)

each side; they have no canine teeth, but there are usually incisor teeth in both jaws; they have generally one or two horns, but some of the earlier extinct species were hornless. One horn was fixed on the bones of the snout (nasal bones), the other on the frontal bones. The horns have no bony centre or core, being entirely made up of longitudinal fibres, like hair, soldered together; they are seldom preserved in a fossil state, but the surface of the nasal bones shows a roughened scar where the horn grew. To give strength to the nasal bones which support the horn when used as a weapon of offence, the division between the nostrils (usually more or less cartilaginous), was hardened by the addition of bony matter so as to form a veritable T-girder.

The Tichorhine Rhinoceros, generally known as the "woolly Rhinoceros" from having a smooth skin without folds, covered with a woolly and hairy coat, like the "Mammoth," had two horns, one very large. It has been found in frozen soil in Siberia with the skin, the horns, and the flesh still preserved.

Its remains occur fossil in rocks of Newer Tertiary age all over the Old World. It was once a denizen of this country, being met with in many limestone caves and also in the Brick-earths of Essex, from which last-named deposit several fine examples may be seen. Five species have been found fossil in this country, three of which inhabited the Valley of the Thames. (*See* Fig. 8.)

There are also placed in these Cases several forms of Rhinoceros, some of which departed widely from the general type.

On one side of Table-case 4 is exhibited a series of the teeth of Rhinoceroses from the Norfolk Forest-bed; from Grays, Essex; from Kent's Hole, near Torquay; from Epplesheim, Hesse-Darmstadt; from the Val d'Arno, &c. On the other side is placed a series comprising several species of *Palæotherium*, an Eocene genus of animals probably related to the Tapir. The remains of this extinct mammal are found at Hordwell, Hants; Bembridge, Isle of Wight; Montmartre, Paris; Vaucluse, Auvergne; Wurtemberg, &c.

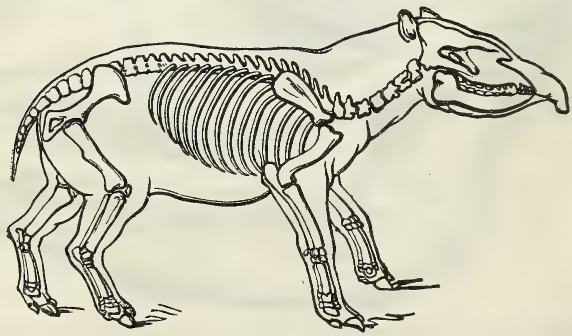


Fig. 9.—Palæotherium, Eocene, Montmartre (restored). (*See* Table-case 4.)

In the small Table-table No. 4A are placed the remains of an allied genus, *Palaplotherium*, from Hordwell, Hants, and Vaucluse, in France; three species of fossil Tapir from the Auvergne, Epplesheim, Minas Geraes, Brazil, and from China; the genus *Lophiodon* from

France; *Coryphodon* from the Eocene of Harwich, Essex; and *Hyracotherium* from the Red Crag of Suffolk and the Eocene of Hordwell.

To the Tapirs and *Palæotheria* succeed the *Equidæ* (Horses). In all modern horses the digits are reduced to a single perfect toe on each foot (Fig. 10. 1); but this character does not hold good for the allied fossil forms, several of which show a tendency to an increased number of toes; but the third is nevertheless always the largest. (*See* the subjoined Woodcut, Fig. 10, giving four examples of the *Perissodactyle* foot, after Marsh.)

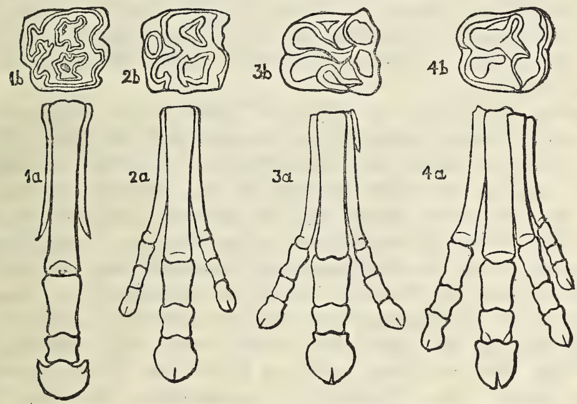


FIG. 10.—Genealogy of the Horse (*Equus caballus*).

1. *Equus.*	2. *Hipparion.*	3. *Anchitherium.*	4. *Orohippus.*
Recent.	Pliocene.	Miocene.	Eocene.
1*a*, Fore-foot.	2*a*, Fore-foot.	3*a*, Fore-foot.	4*a*, Fore-foot.

1*b*, 2*b*, 3*b*, 4*b*, Upper Molar tooth of each genus.

In Table-case 5, and in a part of Pier-case 4, next it, are arranged the fossil remains of the Horse from the Thames Valley Brick-earths; the raised beach at Brighton; Kent's Cave, Torquay; Juvillac and Bruniquel, in France; Eschscholtz Bay, Arctic America; Minas Geraes, Brazil; and from Uruguay, in South America. The present race of Wild-horses, which exist in such vast herds on the Pampas, are not the descendants of the fossil horse of South America, but have sprung from those introduced by the Spaniards 350 years ago. Prior to the Spanish invasion the natives of America are said to have had no knowledge of the horse.

The three-toed Miocene ancestor of the horse (*Hipparion* or *Hippotherium*) occurs fossil in the Sewalik Hills in India; at Pikermi, in Greece; and in France and Germany; whilst *Anchitherium* is met with in France; at Bembridge, in the Isle of Wight; and in Dakota and Nebraska, in North America; and *Macrauchenia*, from the Pleistocene deposits of Buenos Ayres. Remains of two other Tertiary genera (*Homalodontotherium* and *Nesodon*) have been discovered in South America, but their affinities are extremely doubtful.

From the *Perissodactyle* (uneven-toed) division we pass to the cases in which are arranged the remains of the *Artiodactyle* (even-toed) hoofed animals.

In a part of Pier-case 4, and the whole of Pier-case 5 and Table-case 6, adjoining, are arranged the fossil remains of the first genus of this group, the *Hippopotamus*, now confined in the living state to the shores, rivers, and lakes of Africa, but once common in this country, in the Southern parts of Europe, and in India. The series comprises specimens from Malta, Sicily, the Val d'Arno, Italy, and from the Sewalik Hills, India. Its remains have also been found in the Gower Caves, S. Wales, Kent's Cave, Torquay; Kirkdale, and near Leeds, Yorkshire, the Ouse near Bedford; and many remains have been found in the Valley of the Thames in and around London.

The series occupying one side of Table-case 6 represents the fossil remains of one species, *Hippopotamus Pentlandi* (Falc.) obtained from the Grotta di Maccagnone, near Palermo in Sicily. So abundant were the remains of these animals in the various caverns near Palermo that for many years their bones were exported, by ship-loads, to England and Marseilles for the manufacture of lamp-black for sugar-refining. Two hundred tons were removed from one cave (San Ciro) in six months. Dr. Falconer writes that literally tens of thousands of two species of *Hippopotami* have been found fossil in Sicily. He points out, that, at the time these animals lived, Sicily was connected by land with North Africa, and that Malta and Sicily must have been continuous. (*See* "Falconer's Palæontological Memoirs," 1868, 8vo, Vol. II., pp. 544–553.)

On the other side of Table-case 6 are placed limb-bones, vertebræ, and teeth of *Hippopotami* from the Newer Miocene deposits of the Sewalik Hills, India, most of which have been figured in Falconer and Cautley's "Fauna Antiqua Sivalensis."

The Pigs (*Suidæ*) are placed in Table-case No. 7, and comprise many examples of the wild boar from Walthamstow and Grays, Essex; from Limerick, Ireland; from Oreston; and more ancient species from Tuscany and from Pikermi in Greece; also two species, *Sus hysudricus*, and *Sus giganteus*, from India, and the *Dicotyles* (Peccary) from Brazil.

The ancestors of the pigs date back to the Eocene Tertiary. Among them may be counted the fossil genera *Chæropotamus* and *Anthracotherium* (Pier-case 4), *Palæochærus*, *Hyopotamus*, all of which are old Eocene forms of ruminants, from the Isle of Wight and Hampshire coast, and from the Paris Basin, having wider affinities than our modern species, and affording evidence of relationship with more than one group of Artiodactyles.

In Pier-case No. 6 is arranged a group of fossil bones and skulls of animals belonging to the *Ruminantia*,* a division of the even-toed animals, and represented to-day by the Camel, Giraffe, etc.

* From *ruminor*, I chew the cud. A group of Hoofed Quadrupeds (Ungulata) which ruminate or chew the cud.

The most prominent form placed in this case is the *Sivatherium*, a huge beast described by Falconer and Cautley from the Newer Tertiary deposits of the Sewalik Hills, India. It possessed two pairs of horns on its head, two short and simple in front and two larger palmated ones behind them. From the persistent character of these bony horn-cores we may certainly regard this animal as a gigantic four-horned ruminant bearing some resemblance to the living *Antelope* of India.

The fossil remains of the Camel are so closely related to the living species that they cannot readily be distinguished from them. They are found in the Sewalik Hills, India. Representatives of the South American Llamas and Alpacas are also met with in a fossil state.

In Table-case 8 are arranged the fossil remains of some of the earliest-known genera of Ruminants: *e.g.*, *Anoplotherium*, of which six species are represented from the Eocene of the Isle of Wight; Vaucluse and Montmartre in France; *Eurytherium* from the Eocene of Vaucluse; three species of *Chalicotherium* from Sansan in France, from India, and from China; and the *Oreodon* from the Miocene formation of Dakota and Nebraska, in North America.

In Table-case 8A are placed the Eocene genera, *Xiphodon*, from Vaucluse in France, with *Dichodon* and *Dichobune* from the Isle of Wight and Hampshire. These early forms of Ruminants differed from modern sheep and oxen in having canines and incisor teeth in the upper jaw like the Pachyderms (Pigs, Tapirs, Hippopotami, &c.).

CAVICORNIA,* or hollow-horned Ruminants (Antelopes and Oxen). Pier-case 7 is occupied by a remarkable series of heads and horn-cores of fossil Oxen and Antelopes from the Sewalik Hills of India, and a smaller series of remains of the Bison from Siberia, Arctic America, and from British localities.

In Pier-case 8 are arranged the fine series of heads and horn-cores of the gigantic extinct Ox (*Bos primigenius*), from Ilford, Essex, and from peat-deposits and turbaries of Scotland, &c.; also numerous heads of *Bos longifrons*, believed to be the immediate ancestor of our existing small Welsh and Scottish cattle.

Table-case 9 contains a series of heads and other remains of old Indian Antelopes from the later Tertiaries of the Sewalik Hills, India. But the most interesting objects in this case are the fossil remains of the *Ovibos moschatus*, the "Musk-Ox," a denizen of this country in Prehistoric times, and whose remains have been found fossil, associated with those of the Mammoth, at Maidenhead and at Grays, in the Valley of the Thames, and at Slade Green, Kent. The Musk-Sheep is still living on the treeless barrens of Arctic America. (*See* Woodcut, Fig. 11.)

* From *cavus*, hollow; and *cornu*, a horn; the "hollow-horned Ruminants," in which the horn consists of a central bony "horn-core," surrounded by a horny sheath.

Table-case 10 is also occupied by limb-bones and other remains of *Bovidæ*, mostly from Ilford.

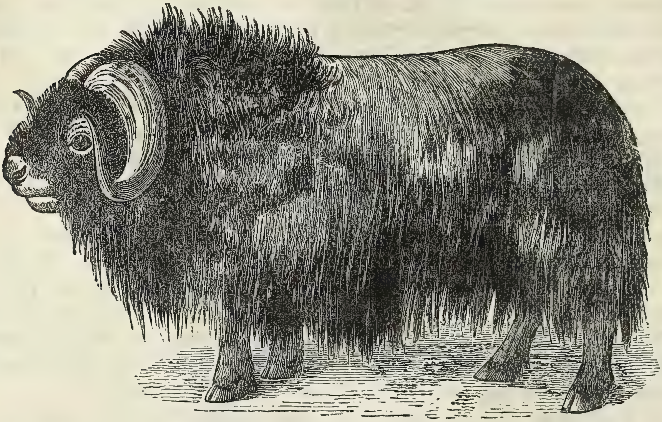


Fig. 11.—The Musk-Ox (*Ovibos moschatus*).

Pier-case 9, and Table-cases 10A and 11.—The Deer-tribe (*Cervidæ*) are solid-horned ruminants with bare antlers* (not covered with a horny sheath supported on a bony core like the oxen). They are well represented both by entire skeletons, in the centre of the Gallery, and also by a fine series of detached heads and horns of various species of the deer-tribe in and upon the wall-cases.

In addition to the Fallow Deer, the Roebuck and the Red Deer, which still linger on (*preserved* in our parks and forests), we once possessed that King of the Deer-tribe, the *Cervus* (*Megaceros*) *hibernicus*, so named from the abundance and perfect preservation of its remains met with in the shell-marls, beneath the peat-bogs in Ireland. An entire skeleton of the male, with antlers spreading a little over 9 feet across,† and of the hornless female stand in the centre of the Gallery. (*See* Fig. 12.) We also had the true elk (*Alces malchis*) and the Reindeer. Thousands of fragments of the shed antlers of the Reindeer have been obtained at Gower, South Wales, from fissures in the limestone rock. The broken skulls with the bases of antlers attached may also be seen from the cave of Bruniquel, and a fine entire antler embedded in stalagmite from Brixham Cave near Torquay. (*See* Wall-case 1.)

The antlers of the deer tribe are shed and renewed annually, increasing in size with age, a new "snag" or tine marking each year, being added to the new antler. The horns of the oxen are never renewed, but last as long as the animal lives.

† Heads and horns of several others are placed on the tops of the adjacent wall-cases. Some are of even greater breadth.

FIG. 12.—The Gigantic Irish Deer *Cervus* (*Megaceros*) *hibernicus*, from shell-marl beneath the peat, Ireland.

ORDER IX.—CETACEA (WHALES, ETC.), AND ORDER X.—SIRENIA (MANATEE, DUGONG, ETC.).

In Wall-cases X. and XIV. at the East end of this Gallery, are placed the fossil remains of the aquatic mammalia of the order SIRENIA and CETACEA, represented at the present day by the Dugong and Manatee, and by the true Cetaceans, the whales and dolphins. The Sirenians are adapted for an aquatic existence; they have a powerful tail-fin placed horizontally (not vertically, as in fishes), and not supported by bony rays. The hind-limbs are almost or wholly wanting; the fore-limbs are modified to form broad swimming paddles or "flippers." In the form of the head they are not unlike the walrus-family, but they have no large tusks, and their molar teeth are adapted for crushing vegetable food—those of the *Halitherium* having a resemblance to the molars of Hippopotamus. An interesting series of the fossil remains of *Halitherium* is exhibited from the Miocene Tertiary beds of Epplesheim, together with *Felsinotherium* from the Pliocene of Italy; *Rhizoprion* from the Middle Tertiaries of France; may be seen in Wall-case X.

The true Cetacea (*see* Wall-case 16) are more fish-like in external form than any other mammals. The nostrils (which may be single or double) are placed at the top of the head, which is generally of disproportionately large size, and is never separated from the body by any distinct external indication of a neck. This family includes the whales, the dolphins and porpoises, the sperm-whales, the ziphioid whales and the Zeuglodons. In these cases are the vertebræ, teeth and jaws of *Zeuglodon* from S. America, and of *Squalodon* from the English Crag; these animals had double-fanged teeth with conoid crowns. Parts of the hard bony rostra of *Ziphius*. The ear-bones and vertebræ of whales, &c., may also be seen in Table-cases 11 and 16: many of them are from the Suffolk and Antwerp Crags, and from the phosphate beds of Charleston, S. Carolina, United States.

THE PAVILION.

ORDER XI.—EDENTATA (Sloth and Armadillo).

Upon a stand in the centre of the floor, very near the entrance to the Pavilion, at the east end of the main Geological Gallery, is placed the cast of the skull and lower jaw, neck-vertebræ, fore and hind limbs, together with the body-armour of an extinct gigantic Armadillo from South America named *Glyptodon*, the separate bones of which are placed in Wall-case No. 12, and in Table-case No. 14, whilst portions of the actual armour-plates occupy a stand on the east side of the Pavilion.

The specimen from which the cast is taken measured from the snout to the end of the armour-plated tail, following the curve of the back, 11 feet 6 inches; the tesselated body-shield being 7 feet in length and 9 feet across, following the curve at the middle of the back.

These large extinct species differed from the modern Armadillos in having no bands, or joints, in their coat of mail, which enable the living species, when attacked, to contract the body into the form of a ball. The seven-banded Armadillo is less than a foot in length, but the great *Glyptodon* was so ponderous and bulky that it could not be overturned, and it only needed to draw up its legs close to its body, so as to rest its carapace on the ground, and bend its armour-plated head down in front, to be perfectly protected on all sides from the attack of any enemy.

On the stand, in the centre of the Pavilion, is placed the cast of the entire skeleton of the great extinct "Ground-Sloth" (*Megatherium Americanum*), the separate original bones of the skeleton, and the skull, occupying Wall-case No. 12, and Table-case No. 14.

This colossal animal measures 18 feet in length, its bones being more massive than those of the elephant. The thigh-bone is nearly

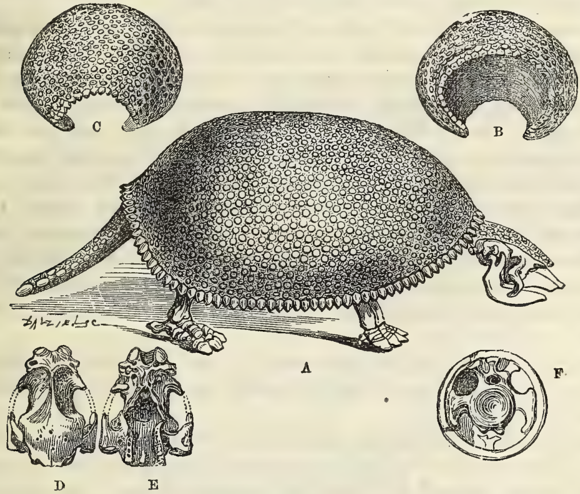


Fig. 13.—Extinct Gigantic Armadillo (*Glyptodon clavipes*) from South America. A, View of entire animal. B, Front end of carapace. C, Back view of same. D and E, Upper and under side of skull. F, Section of tail showing caudal vertebræ inside the bony sheath.

thrice the thickness of the same bone in the largest of existing elephants, the circumference being equal to the entire length. The strength of the *Megatherium* is indicated by the form of the bones, with their surfaces, ridges and crests everywhere roughened for the

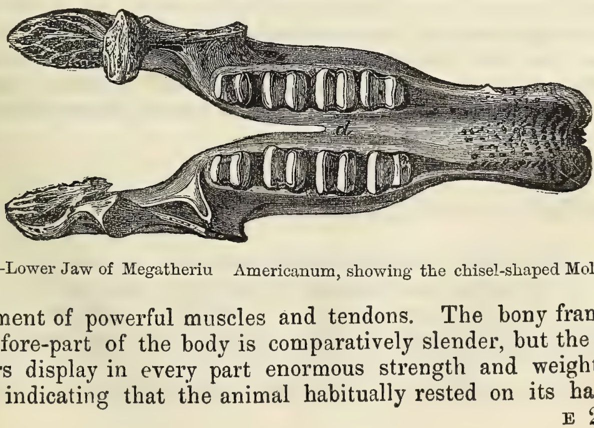


Fig. 14.—Lower Jaw of Megatheriu Americanum, showing the chisel-shaped Molar Teeth.

attachment of powerful muscles and tendons. The bony framework of the fore-part of the body is comparatively slender, but the hinder quarters display in every part enormous strength and weight combined, indicating that the animal habitually rested on its haunches and powerful tail. Whilst in that position it could freely use its strong flexible forearms and the large claws with which its fore-feet were provided to break down or uproot the trees upon the leaves and succulent branches of which it fed, like its pigmy modern representative, the existing tree-sloth, which spends its entire life climbing back-downwards among the branches of the trees.

The jaws are destitute of teeth in front, but there are indications that the snout was elongated, and more or less flexible, whilst the fore-part of the lower jaw is much prolonged and grooved to give support to a long cylindrical, powerful, muscular tongue, aided by which the great sloth, like the giraffe, could strip off the small branches of the trees which, by its colossal strength, it had uprooted.

In the Elephants, which subsist on similar food to that of the *Megatherium*—the grinding of the food is effected by molar teeth which are replaced by successional ones as the old are worn away. In the Giant Ground Sloth only one set of teeth were provided, but these by constant upward growth, and continual addition of new matter beneath, lasted as long as the animal lived and never needed renewal.

Remains of other allied animals, namely, the *Mylodon*, the *Scelidotherium* and the *Megalonyx*, may be seen in Wall-case 12, and in Table-case No. 14.

Although so much larger in bulk than their modern representative, these huge extinct vegetarians of the New World all belong to one family, being classed with the "Great Ant-eaters" in the order EDENTATA (or toothless animals), but the ant-eaters are the only ones in the class that have no teeth, the others having teeth in the sides of their jaws but none in front.

At the time when these animals lived in the vast wooded regions through which the upper waters of the Parana and Uruguay flowed, the lowlands, which now form the extensive "pampas," or grassy plains, of the La Plata, were probably submerged estuarine, or delta areas, over which these great rivers annually deposited the fine sediment which they brought down, together with the bodies of *Megatheria*, *Mylodons*, *Glyptodons*, &c., drowned during floods in the upper valleys where they had their habitat. Hundreds of the fossil remains of these huge herbivora have been met with in this pampas formation exposed in the beds of the sluggish rivers which now traverse these plains.

ORDER XII.—MARSUPIALIA (KANGAROO AND WOMBAT).

Just as the South American Continent had, in past ages, its peculiar group of colossal animals (EDENTATA), represented at the present day by the little banded "Armadillo" and the "Tree-Sloth," so the great Island-Continent of Australia had formerly its peculiar indigenous fauna, which lived, flourished and died, probably before this vast region of the earth had been visited by the human race. Wall-case No. 13, and Table-case No. 15, contain the remains of these large extinct animals belonging to the class MARSUPIALIA—so called because some of them (*e.g.* the Kangaroos) were furnished with a *Marsupium* or pouch in which to carry their young after birth until they were able to care for themselves;—represented at the present day by the Kangaroos.

FIG. 15.—(A.) Skull of gigantic extinct Kangaroo (*Diprotodon Australis*), from the Newer Tertiary Deposits, Australia.
(B.) A human skull placed beside it, to show comparative size.

The largest of this ancient family is called *Diprotodon* (Owen); the skull alone measures three feet in length, being six times as large as the great red kangaroo (*Macropus major*), its living representative. The fore-limbs were longer and the hind-limbs shorter in proportion than in the living kangaroo, and its skeleton was altogether more robust.

Other forms have been named by Professor Owen, *Sthenurus*, *Protemnodon*, and *Nototherium*.

Of the Wombat family only a small living representative is known, of burrowing habits, found in Tasmania, and on the continent of Australia: the extinct forms varied in size from that of a marmot to that of a tapir. The largest of these are named *Phascolomys magnus* and *P. gigas*.

All these animals were herbivorous, subsisting on grass and roots; but one form, remarkably modified from the rest, yet nevertheless of the same marsupial class, was a true carnivore (according to Professor Owen), and preyed upon these old giant kangaroos and wombats. It has been named *Thylacoleo carnifex*.

All the indigenous animals found in Australia both in the past and also at the present day had peculiar modifications of their skeletons characteristic of the class *Marsupialia*, and none are found out of that region of the globe save a single small family called "Opossums," or *Didelphidæ*, found in America. These little animals, with a small banded ant-eater (*Myrmecobius*); the Bandicoot (*Perameles*); with the larger Tasmanian devil (*Sarcophilus*); and the Tasmanian wolf (*Thylacinus*); are either insect-eaters or prey upon animals smaller than themselves.

Most of the remarkable series of remains from Australia were obtained from lacustrine and river deposits on Darling Downs,

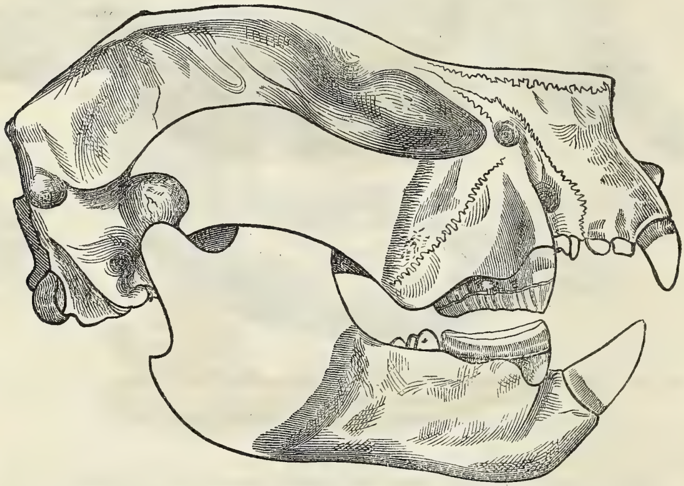


FIG. 16.—Skull of a large extinct Marsupial Carnivore (*Thylacoleo carnifex*), from the Newer Tertiary Deposits, Australia.

Queensland, associated with estuarine shells of the genus *Melania*, and from the Wellington Caves, New South Wales.

The earliest appearance of mammals at present known is in the Trias formation, near Stuttgardt in Germany, and in the Rhætic beds of Frome, Somerset, in which deposits minute detached teeth of some small Marsupial Mammal have been found, whilst in the Oolitic Period, when the Purbeck and Stonesfield rocks were formed, many of these animals must have lived in this country, for no fewer than fourteen genera and twenty-seven species have been founded by Professor Owen and others upon the minute fossil jaws and teeth which have been obtained from these formations. The fossil jaws of these little animals (no bigger than those of a rat or a mouse) may be seen in Table-case No. 15, together with others of a similar class from Brazil.

FIG. 17.—Lower Jaw and Teeth (natural size) of *Triconodon mordax*, Upper Oolite, Purbeck, Dorset.

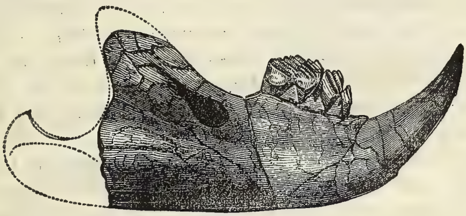


FIG. 18.—Lower Jaw and Teeth of *Plagiaulax Becclesii* (twice natural size), Upper Oolite, Purbeck, Dorset.

FIG. 19.—Lower Jaw and Teeth of *Amphitherium Prevostii* (twice natural size), Great Oolite, Stonesfield, Oxfordshire.

(Natural Size.)

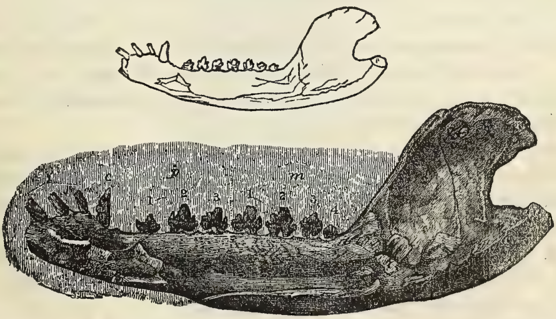


FIG. 20.—Lower Jaw and Teeth of *Phascolotherium Bucklandi*, from the Great Oolite, Stonesfield, Oxfordshire.

CLASS 2.—AVES (Birds).

It had generally been accepted that the most ancient type of birds known were the great wingless running birds, such as the Ostrich, Rhea, Emeu, Cassowary, and Apteryx, and no doubt these may have a very high antiquity,—especially so, if the bird-like tracks met with in the Triassic sandstone of the Connecticut Valley, in the United States, were made by a feathered biped,—but the oldest fossil bird at present discovered is to be seen in Table-case No. 13, in this Room, and named *Archæopteryx macrura* (Owen). (*See* Fig. 21.) This remarkable long-tailed bird was obtained from the lithographic stone quarries of Solenhofen in Bavaria, a rock of the Oolitic formation. The stone is so fine-grained that besides the bones of the wings, the furculum, or "merry thought," the pelvis, the legs and the tail, we have actually casts or impressions on the stone (made when it was as yet only soft mud) of all the feathers of the wings and of the tail. The leg-bone and foot are similar to that of a modern bird, but the tail is elongated like that of a rat, or of a lizard, with a pair of feathers springing from each joint, a character not to be found in any living bird. Quite recently another example has been obtained from the same locality, and is now preserved in the Berlin Museum. A photograph of this specimen is placed near the original fossil.

Here is also exhibited a series of bones of another bird named *Palæornis Cliftii*, from the Wealden formation of Tilgate Forest, and 26 casts of bones of *Hesperornis regalis*, a large bird with teeth, measuring nearly six feet from the extremity of the bill to the end of the toes. In habit it resembled the Loons and Grebes of the present day, but was incapable of flight, and had no visible wings. Its legs and feet were very powerful and admirably adapted for swimming. The teeth of *Hesperornis* were numerous and implanted in grooves, but the extremity of the bill seems to have been protected by a horny sheath, as in recent birds. These bird-remains were discovered in the Middle Cretaceous beds of Kansas, U.S., N. America, by Professor O. C. Marsh, F.G.S., by whom the series of casts were presented. The originals are preserved in Yale College Museum, New Haven, Connecticut, United States.

The next oldest birds whose remains are preserved in this case are from the London Clay of the Isle of Sheppey (Lower Eocene).

One of these, *Dasornis londiniensis*, represented by a single imperfect skull, was as large as an Ostrich, and probably closely related to that bird. Another (*Argillornis longipennis*) rivalled the Albatross in size. A third (*Odontopteryx toliapicus*) had a powerfully serrated bill, well adapted for seizing its fishy prey.

The list of Eocene Tertiary birds is completed by the remains of *Palæortyx Hofmanni*, from the Eocene of Montmartre, Paris.

The remains of Birds are rather more numerous in the Miocene and

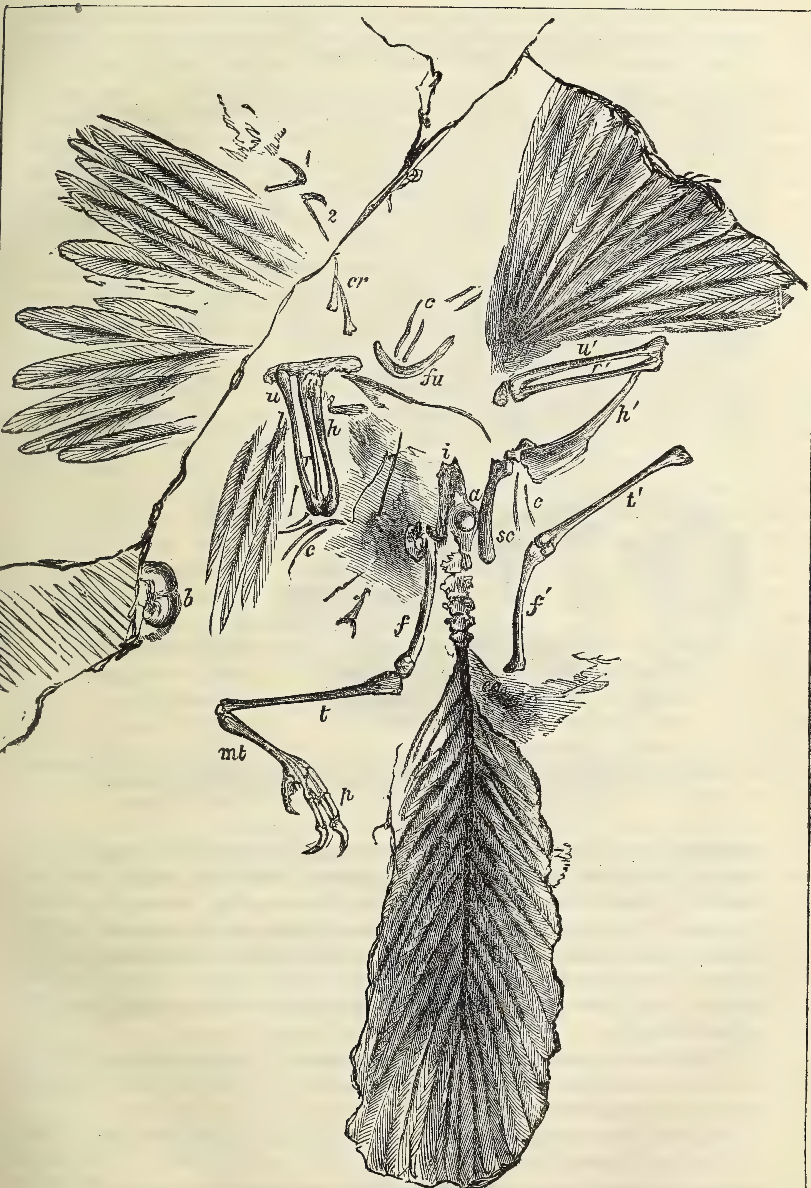


FIG. 21.—The Long-tailed Fossil Bird (*Archæopteryx macrura*, Owen), from the Lithographic Stone, Solenhofen, Bavaria.

Newer Tertiary deposits, though never abundant. Perhaps the most interesting are the bones of a fossil Ostrich (*Struthio asiaticus*), found in the Newer Miocene of the Sewalik Hills, India, showing the once far wider geographical range of this great running bird. The same deposit has yielded remains of a huge Crane (*Argala Falconeri*). Here are also numerous remains of the Pelican, from Steinheim, in Bavaria, and impressions of feathers from the Brown Coal of Bonn, on the Rhine. But the largest assemblage of Miocene birds is from Allier, in France, from which some 69 species have been obtained and described by Professor A. Milne Edwards.

Table-case No. 12 is chiefly occupied with remains of the extinct birds of New Zealand and Australia; comprising casts of bones of a huge eagle (*Harpagornis Moorii*), a gigantic goose (*Cnemiornis*), and a Rail (*Notornis*).

The *Dromiornis*, a large bird, like the Ostrich, is found fossil in caves in Australia.

In a glass case between the windows on the South side of the

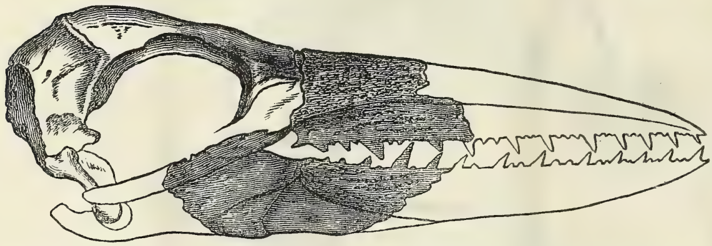


Fig. 22.—Skull of *Odontopteryx toliapicus* (Owen), a bird from the London Clay of Sheppey, with serrated mandibles; probably a fish-eating bird, like the Merganser.

Pavilion are placed portions of the leg-bones and two eggs of an extinct wingless bird, named *Æpyornis* (probably larger than an Ostrich), found in a very modern formation in the Island of Madagascar. The egg of this bird measures 3 feet in its longest circumference and 2 feet 6 inches in girth, and its liquid contents equal a little more than 2 gallons. They are much larger in size than the eggs of the *Dinornis*, which are exhibited in the case on the East side of this Room.

Wall-case 11, and the rest of Table-case 12, are occupied with remains of the great extinct wingless bird the "Moa," or *Dinornis*, from the Island of New Zealand.

Judging from the vast number of remains of this bird, found both in the South and North Island, and also from the fact of the extraordinary diversity in size which their remains exhibit—the *Dinornis* must have enjoyed for hundreds of years complete immunity from the attacks both of man and wild beasts. Professor Owen has described no fewer than 18 species of these extinct running birds, varying in size from 3 to upwards of 10 feet in height.

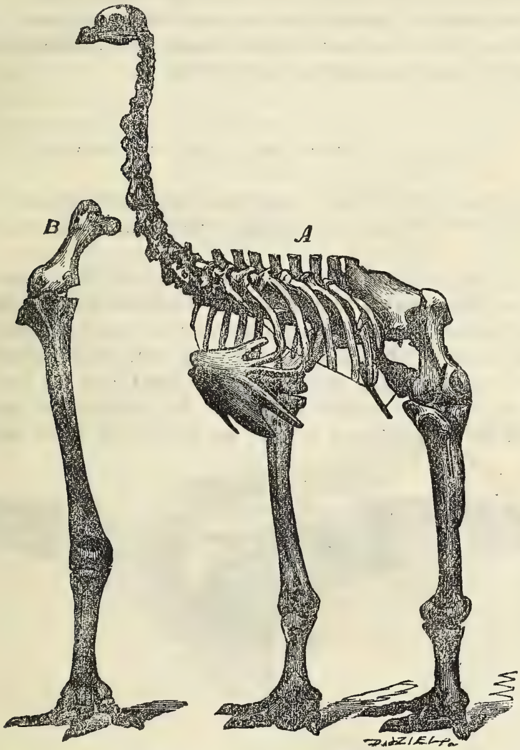


FIG. 23.—A, Skeleton of the "Elephant-footed Moa," *Dinornis elephantopus* (Owen), from New Zealand. B, Leg-bones of *Dinornis giganteus* (Owen), one of the largest of the extinct Wingless Birds of New Zealand.

The ancient Maoris, when they landed, no doubt feasted on these huge birds as long as any remained, and their extermination probably only dates back to a little before these Islands were thrice visited by Captain Cook, 1769–1778. Their charred bones and egg-shells have been noticed by the Honourable Walter Mantell, mixed with charcoal where the native ovens and fires were formerly made; and their eggs are said to have been found in Maori graves.

In July of the present year (1882), the Trustees obtained from a fissure-cave in Otago, New Zealand, the head, neck, and two legs and feet of a "Moa" (*Dinornis didinus*), having the skin still preserved in a dried state covering the bones, and some few feathers of a reddish hue still preserved on the leg. The tracheal rings of the windpipe may also still be seen *in situ*, and the sclerotic plates of the eye and the sheaths of the claws. One foot also shows the hind-claw of the bird (not positively known before) still attached to the foot.

Three nearly entire skeletons of *Dinornis* are placed in cases, one (Fig. 22) in front of the window on the East side, and two on the South side against the wall of this Room, the tallest being over 10 feet in height and the smallest only 3 feet.

Gallery "D." Class 3.—REPTILIA.

Quitting the S.E. Gallery, near its eastern end, we pass by a passage into Gallery "D," which runs parallel with the former on its northern side.

This Gallery is devoted to the exhibition of the remains of fossil Reptilia, a class which includes the Tortoises and Turtles, Snakes, Lizards, Crocodiles, and a large number of extinct forms, the exact zoological position of many of which we can only judge by analogy. Like the Mammalia, the Reptilian class lived both on land and in the water; some being evidently fitted for terrestrial locomotion by their well-developed legs; others, as shown by their paddle-shaped

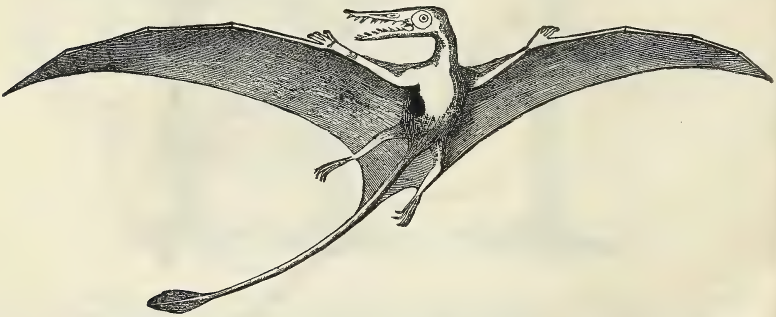


Fig. 24.—Restoration of *Rhamphorhynchus phyllurus* (Marsh), one-seventh natural size, from the Lithographic Stone, Solenhofen, Bavaria.

limb-bones, must have passed their entire existence in the water. One group, now extinct, possessed, like the Bats and the Birds, the power of flight.

In Wall-case 1, and in Table-cases 1 and 2, are placed the fossil remains of this last-named group of "Flying Lizards" or Pterodactyles. These animals had the centra of the vertebræ hollow in front; they possessed a broad *sternum* or "breast-bone," with a median ridge or keel, similar to that of birds; the jaws were usually armed with teeth fixed in sockets.* The fore-limb had a short humerus, a long

* A remarkable genus of Pterodactyles has lately been discovered and described by Prof. Marsh in North America, and named *Pteranodon;* they were wholly destitute of teeth, and probably had their jaws encased in horny beaks like birds.

radius and ulna, and one of the fingers of the hand was enormously elongated to give support to the wing-membrane, which was attached to the sides of the body, arm and hand, and also to the hind-limb and tail, which in some genera (as in *Rhamphorhynchus*) was greatly elongated and stiffened with slender ossified fibres. The other fingers of the hand were free and furnished with claws. The wing-membrane appears to have resembled that of the Bat, being destitute of feathers. The bones were pneumatic (*i.e.* filled with large air-cavities), the walls

Fig. 25.—Skeleton of Flying Lizard (*Pterodactylus crassirostris*), from the Lithographic Stone, Solenhofen, Bavaria.

of the bones being very thin and compact, thus combining strength and lightness.

Numerous remains of nearly perfect Pterodactyles, both with long and short tails, and varying greatly in size, have been obtained from the Solenhofen Limestone in Bavaria—others occur in the Great Oolite at Stonesfield, near Oxford; and in the Lias formation, Lyme Regis, Dorset. The most remarkable of these English examples is the *Dimorphodon macronyx* from the Lias of Lyme, which had a large head, the jaws armed with lancet-shaped teeth, a long tail and well-developed wings. The skull was 8 inches in length and the expanse of the wings about 4 feet. (Owen.)

The Flying Lizards of the Chalk and Greensand, however, attained a far larger size—but their remains are all very fragmentary. For example, some detached vertebræ of the neck of one species have been found in the Cambridge Greensand, measuring 2 inches in length, and portions of humeri 3 inches broad. Such bones give evidence of a flying lizard having probably an expanse of wings of from 18 to 20 feet. The Pterodactyles of the Chalk of Kent were nearly if not quite as large. These singular flying reptiles do not appear to have lived longer than the period of time represented by the deposition of the strata from the Lias formation to the Chalk. They are now entirely extinct.

In this case (1) are also placed the remains of the great aquatic Lizard-like reptile which once inhabited the shores of the sea in which the Uppermost Chalk, or Maestricht beds were deposited, and known as the *Mosasaurus*, whose powerful jaws, armed with great grooved, recurved, conical teeth, have been obtained from St. Peter's Mount, near Maestricht, and (under the name of *Leiodon*) from the Chalk of Norfolk and Kent. Remains of over forty species of this tribe have been found in the Cretaceous rocks of New Jersey,

B A

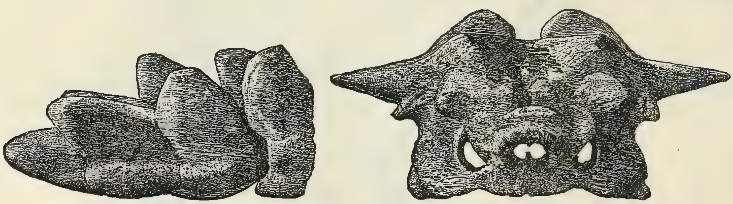


FIG. 26.—A, The Skull, and B, Tail-sheath, of the great Horned Lizard (*Megalania prisca*, Owen), from the Newer Tertiary deposits of Australia.

Kansas, &c., in North America. One of these, the *Mosasaurus princeps*, is computed to have been 75 to 80 feet long. The body was covered with small overlapping bony plates. The paddles, which were four in number, each with five digits, had a remarkable resemblance to the "flippers" of a whale.

Here are also placed the remains of a great extinct land-lizard (*Megalania prisca*, Owen) from Australia, 14 feet, or even more, in length, with nine horn-like prominences on its skull, which measured 1 foot 10½ inches in breadth. The skull, at first glance, looks like that of some flat-headed form of Ox; but the bones are altogether dissimilar, and the jaws are without teeth. It was probably a vegetable-feeder, like its pigmy living representative (*Moloch horridus*), also from Australia, which has horny prominences on its skull, but the entire length of this little lizard is only 7 inches.

Since the two papers by Professor Owen (Phil. Trans. for 1858 and 1880) on this curious and huge lizard have appeared, a further portion of its remains have been sent over, showing that it possessed a tail encased in a horny sheath (*see* Fig. 26, B), so like the armour-plated tail of the great extinct non-banded Armadillo (*Glyptodon*) from South America, that had the tail arrived before the head and vertebræ had been received, it might well have been cited to prove the former existence of the *Glyptodon* in Australia. Other fossil remains of Lacertilia occupy Table-cases 2 and 3.

OPHIDIA (Serpents).—These are rarely met with in a fossil state, but a few such remains have been obtained from the Tertiary rocks: one of these, the *Palæophis toliapicus*, has been obtained from the London Clay of Sheppey; others are recorded from the Miocene of Œningen and the Lignites of Bonn-on-the-Rhine. (See Table-case 6.)

The CROCODILIA (which are placed in Wall-case 2, and in Table-cases 3–6) had the body covered with a thick layer of oblong bony plates or scutes, pitted on the surface, and covered with a horny substance. They have a single row of teeth in distinct sockets, which are continually being renewed from below; the joints of the backbone in these reptiles are either cup-shaped or concave at both ends, as in *Teleosaurus;* or concave in front and convex behind, as in the Crocodile from Sheppey, and in all living Crocodiles. Professor Owen has constituted two groups, based on these modifications of the backbone. Of the earliest of these Crocodilian reptiles one is named *Belodon*, having long and pointed slightly-curved teeth, longitudinally grooved, and with elongated jaws like the modern Gavials: the other, named *Stagonolepis*, resembled the existing Caimans, but with an elongated skull like the Gavials; the body was covered by bony scutes. Both these reptiles are from the Trias, the latter from Elgin, Scotland; the former from Stuttgart, Germany. In the Oolitic and Liassic series the old type of long and slender-jawed Teleosaurs and Steneosaurs with strong bony scutes was abundantly represented.

From the Purbeck beds of Dorset we have a true Crocodilian, the *Goniopholis;* and a dwarf species, *Theriosuchus pusillus*, Owen.

A large Crocodile has been obtained from the Eocene Tertiary of the Isle of Wight and from Hordwell, Hampshire; and remains of many species of Alligators, Crocodiles and Gavials, from the Tertiary rocks of India, may be seen in this case.

The DINOSAURIA, Land-Reptiles (Wall-cases 3, 4, and 5, and Table-cases 7–12).—This remarkable group of huge terrestrial reptiles is quite extinct. In some of them there appear to have been bony dorsal plates and spines present, others were without such defences. Most of these animals had flat or biconcave centra to their vertebræ, a few of the anterior vertebræ had hollow cups behind. Two pairs of limbs were always present, furnished with strong-clawed digits.

They were probably to some extent amphibious in their habits, but their limbs were well fitted for progression on the land.

The skeleton of a small Dinosaurian reptile, of which a beautiful cast may be seen in Table-case 3, the original being preserved at Munich, named *Compsognathus longipes*, has been found entire in the Lithographic stone of Solenhofen, and from the relative proportions of its limbs we cannot but conclude that it must have "hopped, or walked in an erect or semi-erect position,* after the manner of a bird, to which its long neck, slight head, and small anterior limbs must have given it an extraordinary resemblance" (Huxley).

"Mantell's *Iguanodon*."—The slab in the centre of Case 3 contains a great portion of the skeleton of a young individual of *Iguanodon Mantelli* from Bensted's Kentish Rag quarry at Maidstone. This is one of the largest of the great extinct land-reptiles, some of which certainly rivalled the elephant in bulk.†

The femur (thigh bone) alone measured 4 to 5 feet in length. The fore-limbs were very short, so that it is almost certain that it did not make use of them for progression on the ground, but supported itself habitually in an upright position by the aid of its long and powerful tail, after the manner of a kangaroo.

This great reptile was a vegetarian in its diet, as is proved by its

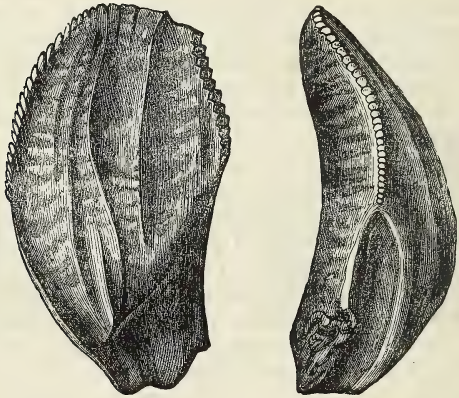
A  B

FIG. 27.—A, Front view; B, Side view of Tooth of *Iguanodon* (natural size), Wealden, Isle of Wight.

teeth, which correspond with those of the living and vegetable-feeding *Iguana* of S. America.

Their fossil teeth are not unfrequently found worn down at the crown, like the grinders of an elephant. They were implanted in distinct sockets, and a succession of teeth always growing up from beneath, replaced the worn-down stumps. The teeth are curved and leaf-shaped in form, and the edges are elegantly serrated, a character peculiar to all the vegetable-feeding Dinosaurs, such as *Acanthopholis*, *Scelidosaurus*, and the South African genera, *Anthodon* and *Nythosaurus*. (*See* Woodcut, Fig. 27.)

In the centre of Wall-case No. 4 is placed the great block of

* Or like a Jerboa

† As many as twenty-four of these huge reptilia were recently obtained from the Wealden of Belgium, and an almost complete skeleton has been put together in the Brussels Museum, proving it to have been more than 30 feet in length.

septarium from the Kimmeridge clay of Swindon, Wilts, containing the femur, pelvis, and a large portion of the skeleton of another huge Dinosaur,* named *Omosaurus armatus* by Prof. Owen.

The femur is over 4 feet in length, and the humerus nearly 3 feet and enormously broad. The bones of the fore-limb and many of the vertebræ of *Omosaurus* were found in the clay near the chief mass.

Numerous other fine Dinosaurian remains are to be seen in these cases. As we do not know the teeth of many of these huge reptiles, we cannot speak positively as to their habits; but it is certain that from the Trias to the Chalk two groups have existed, side by side, one having a carnivorous dentition, and the other being herbivorous. The *Teratosaurus* of the Trias of Stuttgart and the *Lycosaurus* and *Cynodraco* from the Cape; the *Megalosaurus* of the

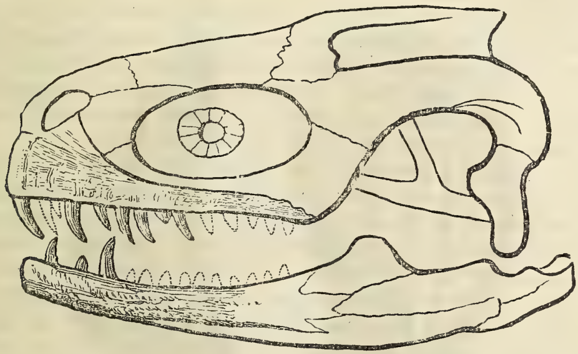


Fig. 28.—Profile of Cranium and Lower Jaw of *Megalosaurus*, restored in outline (after Professor Phillips), from the Oolite.

Oolitic and Wealden strata were all carnivores. But of *Polacanthus*, *Omosaurus* (Wall-case No. 4), *Hylæosaurus* (Wall-case No. 5), and *Cetiosaurus*† we have no direct dental evidence. No doubt, as amongst the Mammalia at the present day, the majority were vegetable-feeders, and the minority were predaceous in habit.

In Table-case No. 12 are placed two nearly entire skeletons of a small, but very remarkable amphibious reptile, named *Neusticosaurus pusillus*, from the Trias near Stuttgart, Germany; having affinities with both the terrestrial and marine lizards. In the long neck and form of the fore-limb this reptile approaches *Plesiosaurus;* in the hind-limb it presents affinities with the earliest of the fossil Crocodiles.

In Wall-case No. 9, and Table-cases 23 and 24, are placed the

* This specimen forms a lasting monument to the rare scientific ability of Mr. William Davies, F.G.S., Assistant in the Department of Geology, under whose direction it was exhumed, and was, with the aid of the skilful mason, Mr. Barlow, developed from its shapeless and intractable matrix.

† A single tooth has been found in the same quarry at Enslow Bridge near Oxford, from which the bones of *Cetiosaurus* were obtained; it is like that of Iguanodon.

series of remains of reptilia from the Trias of S. Africa referred by Prof. Owen to the genera *Lycosaurus*, *Ptychognathus*, *Oudenodon*, *Endothiodon*, &c.

Chelonia.—In Wall-cases 6 and 7, and in Table-cases 17, 18, 19, and 20, are placed the fossil remains of the order Chelonia, in which are included Tortoises and Turtles, a group of reptiles in which the backbone and ribs are immovable, being combined with the external coat of bony plates, closely soldered together, enclosing the entire body of the animal. This box-like envelope is covered with leathery skin or horny plates; one kind of which is called "tortoise shell," and is made into combs, &c. The bones of the skull (except the lower jaw and the hyoid bones) are also consolidated. They have no teeth, but the jaws being encased in a horny beak, the sharp edge serves instead for dividing the food.

The Chelonians are found living at the present day on land, in fresh water, and in the sea; they are all oviparous, depositing their eggs in the sand, to be hatched by the warmth of the sun. Some recent Turtle's eggs from Ascension, cemented together and fossilized in shell-sand by deposition of lime, produced by evaporation of sea-water, are placed in Table-case No. 18.

Some of the old gigantic land-tortoises (of which a few only survive) inhabited Mauritius and other islands of the Indian Ocean and the Galapagos Islands in the Pacific. Like the Dodo, they have been gradually exterminated by the hand of man. The largest of the fossil forms (a restored cast of which is placed on a stand at the west-end of this gallery) is the *Colossochelys atlas* from the Sewalik Hills of India. The detached fragments (*vouchers* for the size of this great carapace) are placed in the adjacent Wall-case (7). These old land-tortoises, so remarkable for the magnitude they attained, had extremely long necks and small heads; they were all vegetable-feeders and quite harmless.

Several smaller species of Chelonians are also to be seen in this case from the same Indian locality.

In Wall-Case 6 are placed the remains of the great *Chelone Hoffmanni* from the Chalk of Maestricht; the *Chelone gigas*, Owen, whose head and some other parts are exhibited here, from the London clay of Sheppey, was even larger. These were true marine turtles, related to the "Loggerhead" Turtle of the present day.

One small species of *Emys*, or Marsh Tortoise, was formerly an inhabitant of this country, and its remains have been found fossil in Norfolk.

The oldest Chelonians we know are found fossil in the Great Oolite formation, but judging from certain footprints in the Triassic sandstones, they may have existed at even an earlier date.

In Wall-case 10, and in Table-case No. 16, are placed the remains of one of our largest marine reptiles, the *Pliosaurus*, found fossil in the Kimmeridge clay near Ely, and also in Dorsetshire. We have no entire skeleton of this animal, but a single swimming-paddle

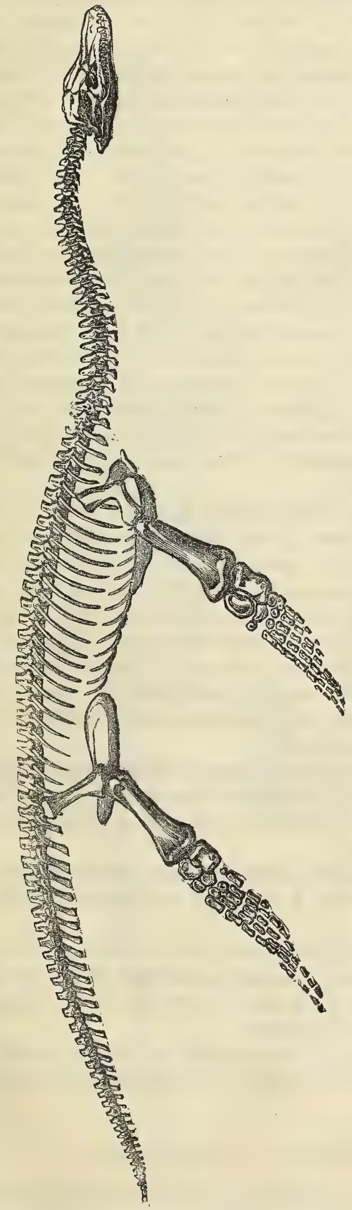


FIG. 29.—Skeleton of the Long-necked Sea-Lizard (*Plesiosaurus*), from the Lias of Lyme Regis, Dorset.

measured 7 feet in length; its jaw was 6 feet long, and one of its teeth was 15 inches in length. It had a shorter neck than the *Plesiosaurus*, but was probably less fish-like in aspect than *Ichthyosaurus*, which latter reptile it outrivalled in point of size.

In Wall-case 11, and in Table-case No. 15, are arranged the extinct group of marine reptiles, the PLESIOSAURIA. (*See* Woodcut, Fig. 29.) They are distinguished at once by the great development of the neck, which is composed of numerous vertebræ. The head is comparatively small in size; the orbits were large; the limbs were shaped externally like the flippers of a whale, and made up of 5 fingers, composed of numerous phalanges. The jaws were armed with many simple pointed teeth inserted in distinct sockets. The most complete examples are the *Plesiosaurus Hawkinsii*, the *Pl. robustus*, the *Pl. laticeps*, all in Case 11; and the cast of the great *Pl. Cramptoni* (on the wall of the passage leading to the S.E. gallery), which is 22′ 0″ in length and 14′ 0″ in breadth, measuring across its expanded paddles.

Most of these old Marine-Lizards, both the long and the short-necked forms, were obtained from the Lias of Street, Somersetshire, Lyme Regis, Dorsetshire, Barrow-on-Soar, Leicestershire, and Whitby, in Yorkshire.

Wall-case 12, and Table-cases Nos. 13 and 14, ICHTHYOSAURIA, "Fish-Lizards."—These great marine reptiles had very short necks (*see* Woodcut, Fig. 30), probably not visible at all externally; the vertebræ were numerous and deeply biconcave; the skull had very large orbits, and the eyes were surrounded by a ring of broad bony (sclerotic) plates. The jaws were elongated, and armed with powerful teeth implanted in distinct sockets. The fore and hind limbs were converted into fin-like organs, composed of short polygonal bones, arranged in five closely approximated rows, with supernumerary rows of marginal ossicles added.

The largest entire *Ichthyosaurus* is from Lyme Regis, and measures 22 feet in length and 8 feet across the expanded paddles; but detached heads and parts of skeletons prove that they often attained a far larger size than this.

In some of the Ichthyosaurs the jaws are prolonged into a long and slender rostrum; others have short and robust heads, and jaws armed with large teeth.

These old marine lizards must have exercised the same repressive action over the teeming animal population of the old Liassic seas that the sharks do in our seas at the present day. Their distribution is similar to that of *Plesiosaurus*.

In Wall-case No. 9, is arranged a further series of S. African reptilia belonging to the division ANOMODONTIA (Owen), such as *Dicynodon*, &c.

CLASS 4.—AMPHIBIA.

In Wall-case No. 8, and in Table-cases Nos. 21 and 22, are placed the fossil AMPHIBIA (Frogs, Toads, Newts, and Salamanders).—These

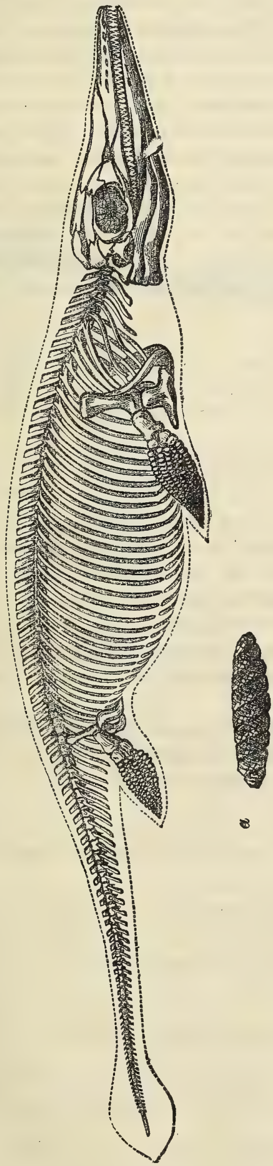


FIG. 30.—Skeleton of the Short-necked Marine Fish-Lizard (*Ichthyosaurus*), from the Lias of Lyme Regis, Dorset. *a* represents one of the fossil coprolites of this animal.

animals are distinguished from true reptiles by the fact that the young undergo certain metamorphoses after leaving the egg. In this stage of their existence they breathe by external gills; these gills are occasionally retained along with internal lungs in the adult animal. The limbs are sometimes all absent, or one pair may be wanting. When present, they have the same bones as in the higher animals; they are never converted into fins. There are never more than two vertebræ coalesced to form the sacrum. The centrum of the backbone is sometimes found to be unossified, forming a mere ring of bone, the

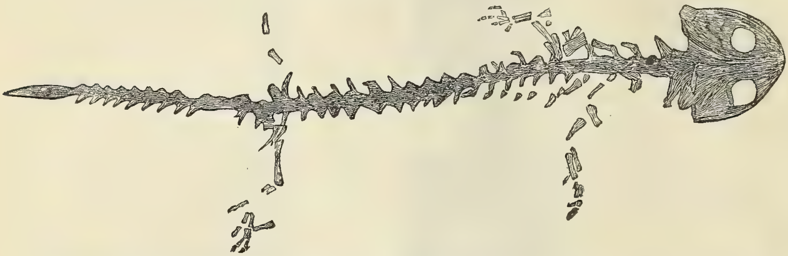


FIG. 31.—The great Fossil Salamander from Œningen (*Cryptobranchus homo-diluvii-testis*), Scheuchzer, sp.

interior being gelatinous. This form of backbone is called "Notochordal," and is characteristic of the oldest reptilia belonging to this group met with fossil in the Coal Measures, such as the *Anthracosaurus*, *Archægosaurus*, and the Triassic *Labyrinthodon*.

The Salamanders are represented by the great fossil form from the Miocene of Œningen (*see* Table-case 21), which, when first discovered, in 1726, was described by Scheuchzer as "*homo-diluvii-testis*," the man who witnessed the Deluge!

The tail-less *Batrachia*, or frogs and toads (Table-case 21), have been found fossil in the same freshwater deposit, and also in the Brown Coal of Bonn-on-the-Rhine.

GALLERIES RUNNING NORTH FROM THE REPTILIAN GALLERY.

There are seven Galleries running at right angles to the Reptilian Gallery, about 140 feet in length; three of which are forty feet in breadth, and four are of half that width. No. 1 is occupied by the Library.

CLASS 5.—PISCES (FISHES).

The first wide Gallery (A) is devoted to the exhibition of the Fossil Fishes, and contains thirty-two Table-cases, and about 260 feet linear of Wall-cases.

Here are exhibited the finest collection of Fossil Fishes ever brought together in any museum. This class was always well represented in this Museum, but it has lately received two splendid additions by the acquisition of the famous collection of the Earl of Enniskillen, from Florence Court, Ireland; and that of the late Sir Philip de Malpas Grey-Egerton, Bart., M.P. (Trustee of the British Museum), of Oulton Park, Tarporley, Cheshire; both obtained within the present year (1882).

The incorporation of these large collections, and the introduction of twelve additional Table-cases into this Gallery, prevents a detailed account of its contents being given at present. A full description will shortly be issued in a subsequent Edition of the Guide.

This terminates the series of Vertebrate fossils, and in the next Gallery we commence with the INVERTEBRATA (animals without a backbone)—such as Cuttlefishes, Snails, Oysters, Insects, Crabs and Lobsters, Worms, Sea-urchins, Corals, &c.

INVERTEBRATE ANIMALS.

Division A. MOLLUSCA (soft-bodied animals).

Class 1.—CEPHALOPODA.

Narrow Gallery No. 2 has just been fitted up with Wall-cases, and sixteen Table-cases for the display of the fossil CEPHALOPODA,* being the first section of the Invertebrate animals and the highest division of the Molluscan Class.

The animals of this class are all marine, and are provided with long feelers or tentacles (sometimes called feet) attached to the head around the mouth, whence the name Cephalopoda, or "head-footed," is derived. Here are placed the fossil representatives of the existing *Octopus*, and the Squids and Cuttlefishes, the delicate Paper Nautilus and *Spirula*, also the Pearly Nautilus. These are divided into two great groups, the *Dibranchiata*, or two-gilled, and the *Tetrabranchiata*, or four-gilled Cephalopods.

The first of these includes the most active free-swimming forms to which all the living genera belong, save one solitary survivor, "the Pearly Nautilus."

Most of them have a delicate internal shell, often quite minute or rudimentary, as in *Octopus*, or divided into chambers by septa or partitions, as in *Spirula*.

The delicate shells of *Spirulirostra*, *Beloptera*, &c., occur in the Miocene and Eocene Strata. Impressions of "Squids" showing the soft parts of the body, the arms, and the "ink-bag" are found in the Chalk of the Lebanon, Syria; the Oxford Clay of Wiltshire; the Solenhofen Limestone of Bavaria; and the Lias of Lyme Regis, &c.

The "Belemnite," so common a fossil in the Cretaceous and Oolitic rocks, is only the shelly extremity or "guard" (like the tip of a spear, or dart, without barbs), forming part of the internal shell of an extinct

* From κεφαλή, head, and πους, ποδος, a foot; hence "head-footed."

kind of Squid, or Cuttlefish, which, when perfect, had a chambered upper portion to its shell (called the "phragmocone"), and a pearly extension beyond (called the *pro-ostracum*). Some nearly perfect examples have been found in the Lias and Oxford Clay (see Table-cases). The arms were provided with hooklets as well as suckers for holding fast its prey, and each animal had an ink-bag that secreted an inky fluid (known as *Sepia*, and used as a pigment by artists), which could be ejected into the water at pleasure, so as to conceal the animal's retreat by a cloud of inky blackness.

They all had strong horny or shelly mandibles, resembling a parrot's beak; these are frequently met with in a fossil state.

By far the largest proportion of the fossil forms, however, belong to the Tetrabranchiate, or four-gilled division, represented at the present day by the "Pearly Nautilus" of the Indian Ocean. These were less active forms than the Squids and Cuttlefishes; and instead of having, like them, an internal shell, they had a strong external one with a pearly lining, in the large body-chamber of which the soft parts of the animal were enclosed. The rest of the shell is divided by septa, or partitions, into a series of chambers usually filled with fluid, through which a tube passes called the "siphuncle."

All the beautiful and varied forms of *Turrilites*, *Baculites*, *Ammonites*, *Ceratites*, *Goniatites*, *Orthoceratites*, &c., belong to this great division of the Cephalopoda.

The shells of the Pearly Nautilus have been obtained in large numbers from the London Clay of Highgate, Hampstead, and the Isle of Sheppey; the Ammonites in infinite variety of pattern occur from the close of the Cretaceous period to the base of the Secondary rocks; the *Ceratites* in the Trias, and the *Goniatites* in the Carboniferous formations, being only modifications of the shells of the same family.

The older forms chiefly belong to the straight *Orthoceratites*, having shells like a Nautilus uncurled and straightened out, or to curious forms, having various degrees of curvature in the shell, between the straight Orthoceras and the involute Nautilus and Ammonite. These variations are also found in many genera of Cephalopod Shells of the Chalk period. A fuller description of the contents of this Gallery will be given in a new Edition of the Guide as soon as the Wall-cases are arranged, but they are not yet available for the reception of specimens.

Class 2. Pteropoda (wing-shells).—A single Table-case is devoted to this curious division of Mollusca, represented at the present day by small oceanic animals, whose entire life is passed in the open sea far away from any land, swimming by means of two wing-like appendages, one on each side of the head). The Pteropods had their representatives far back in past geological time.

In the Miocene beds of Bordeaux, Dax, Turin, Sicily, and in the Suffolk Crag, small delicate shells occur, like existing genera, such as *Hyalea*, *Vaginella*, *Cuvieria;* whilst in the Carboniferous, Devonian, and Silurian many species are met with, as *Conularia*, *Hyolithes*, (*Theca*), &c., which attained a large size compared with the minute shells of living members of this class.

Gallery B.—The second of the wide Galleries has thirty-two Table-cases and Wall-cases corresponding with Gallery A. In it are placed the remaining groups of the Mollusca, viz., the Gasteropoda, the Lamellibranchiata, and the Brachiopoda. It also contains the Polyzoa, the Insecta and Crustacea, the Annelida and Echinodermata.

Class 3. Gasteropoda (Snails, Whelks, &c.).

Class 4. Lamellibranchiata (Oysters, Cockles, &c.).

The fossil shells of the above groups occupy the whole of the West or left side of this Gallery and a small portion of the East or right side. Wall-cases 1–9 contain the Foreign Mollusca, and Table-cases 89–104 the British specimens of the same group. The Gasteropods, or Univalves, are placed first in each case, and the Lamellibranchs, or Bivalves, follow them. The whole series are subordinately arranged in Stratigraphical series, commencing with the most recent deposits, such as the Peat, Raised-Beaches, Glacial-deposits, and going back in time to the Silurian and Cambrian periods.

Attention is drawn to the fine series of Mollusca from the French, Italian, and English Tertiary strata, particularly to M. Deshayes's beautiful collection of shells from the Eocene strata of the Paris Basin (Wall-cases Nos. 3 and 4), and the Miocene of Bordeaux (Wall-cases Nos. 1, 2, and 3). To our own Eocene shells from Highgate, Bracklesham, Barton, and the Isle of Wight (see Table-cases Nos. 100, 101). This Molluscan fauna of the South-east of England indicates the former existence of a much warmer climate in Britain than we now experience. For such genera as *Nautilus*, *Conus*, *Voluta*, *Cypræa*, and *Pleurotoma*, then so abundant, do not now live on our coasts, but must be sought for in subtropical seas.

On the West wall, between Wall-cases 6 and 7, is placed a fine slab of "Petworth Marble," entirely composed of the shells of a fresh-water snail (*Paludina*). The elegant columns of the Temple Church, Fleet Street, are made of this same marble from the Weald of Sussex.

In Wall-cases 5 and 6 are placed the curious shells called *Hippurites*, allied to the existing Chamas. They probably lived clustered in Coral-reefs like their modern representatives. They are seldom met with in the Cretaceous rocks of this country, but the "Hippurite limestone" is largely developed on the Continent, in France, Spain, and Italy; it also occurs in the East and West Indies.

Among the Oolitic and Cretaceous Mollusca may be noticed the shells of three genera, rarely obtained living in the seas of to-day, namely, *Pleurotomaria* (Table-case 93 and Wall-case 7), *Pholadomya* and *Trigonia* (Table-cases 92–98). Only four recent specimens of *Pleurotomaria* have been obtained, one of which realized the sum of £25. A single living species of *Pholadomya* is known from the West Indies; whilst *Trigonia* only occurs in the seas of Australia.

Class V. Brachiopoda ("Lamp-shells," ex. *Terebratula*).—The British collection of Brachiopods or "Lamp-shells" occupy Table-cases 86, 87, and 88. The Tertiary, Cretaceous, Oolitic, Carboniferous, and Devonian forms being well represented, also those of the Upper Silurian strata.

The foreign species occupy Wall-cases 10 and 11. The Brachiopoda have received special attention from Mr. Thomas Davidson, LL.D., F.R.S., who has devoted his whole life to the study, illustration, and description of this class of the Mollusca. Many of the specimens figured by him may be seen in the collection.

Class VI. Polyzoa (Sea-mats and horny Corallines).—These elegant organisms, so frequently found upon the sea-shore, and often confounded with sea-weeds (Algæ), are really the horny or calcareous composite habitations of numerous distinct but similar microscopic zoöids, each individual occupying a minute double-walled sac, in a common habitation, called a *cœnœcium*, or *polyzoarium*.

They are met with in great variety of form in the Coralline Crag of Suffolk, in the Miocene of Dax, Bordeaux, and Touraine, and in the Eocene Beds of the London and Paris Basin.

Beautiful masses of *Fenestella* are found in the Permian or Magnesian Limestone of Durham, and in the Permo-Carboniferous rocks of Australia and Tasmania. The Polyzoa of the Carboniferous formation are also numerous and varied. The most singular of these is the *Archimedipora*, which has its *cœnœcium*, or *polyzoarium*, arranged around a central screw-like axis, giving it a most elegant geometrical form.

Division B. Arthropoda (Jointed Animals).

Class 1. Insecta (ex. Beetles, Flies, Bees, &c.).
,, 2. Myriapoda (ex. Centipedes, Millipedes).
,, 3. Arachnida (ex. Spiders, Scorpions, &c.).

Insects, Myriapods, and Arachnida are very rare in the rock-formations of this country. They have, however, been met with in considerable numbers in the Eocene strata of Gurnet Bay, Isle of Wight, in the Purbeck Beds of Swanage, Dorset, in the Great Oolite of Stonesfield, the Lias of Warwickshire, the Coal-measures of Coalbrook-dale, and Scotland, &c. (see Table-case 84). They are more abundant in the Brown Coal of Bonn; in the Amber from the Miocene Beds of Samland on the Baltic; from Œningen, near Constance; and from the Lithographic Stone of Solenhofen, Bavaria. From the last-named locality beautiful Dragon-flies (*Libellulæ*) and numerous other genera have been obtained (see Wall-case No. 12).

Class 4. Crustacea (ex. Crabs and Lobsters).—The Foreign Crustacea occupy Wall-cases 12, 13, and 14, and the British forms fill four-and-a-half of the adjoining Table-cases—80–83. Those

British specimens too large for the Table-cases are arranged on the top shelf of the Wall-cases. Attention is directed to Table-case No. 80, in which is exhibited a beautiful series of Trilobites from the Wenlock shale and limestone near Dudley. Many of these Silurian Crustaceans are remarkable for great beauty and variety of form, and exhibit, in some instances (as in *Phacops*), the singular compound eyes; and in *Encrinurus*, the eyes placed upon long eyestalks.

The largest of the British Trilobites (*Paradoxides*) exceeds 2 feet in length (see Wall-case No. 14B), whilst the nearly-allied genus *Pterygotus*, from the Old Red Sandstone of Forfarshire, measured fully 5 feet in length (see Wall-case 13).

Division C. ANNULOSA (Ringed animals).

Class 1. ANNELIDA (ex. Earth-worms, Sand-worms, Tube-worms, &c.).—Sea-worms (Table-case 79 and Wall-case 15), being soft-bodied animals, are seldom preserved in a fossil state; but their existence is proved by the tracks, burrows, and worm-castings which they have left on the wet mud, and upon the ripple-marked sands of the old sea-shores, before these had become hardened into shales and sandstones; their microscopic teeth have also been found in a fossil state in the Lower Palæozoic rocks. Some species form shelly tubes,* and these are frequently found in a fossil state in rocks both of Palæozoic and Secondary age.

Division D. ECHINODERMATA (Spiny-skinned Animals.)

1. ECHINOIDEA (Sea-urchins, *Cidaris*).
2. ASTEROIDEA (Star-fishes).
3. OPHIUROIDEA (Brittle-stars).
4. CRINOIDEA (Stone-lilies).
5. CYSTOIDEA.
6. BLASTOIDEA.
7. HOLOTHUROIDEA (Sea-cucumbers).

The animals grouped in this division are very different in appearance, but agree in having their soft parts enclosed within a more or less solid calcareous covering, composed of numerous plates, disposed usually in a distinctly radial arrangement.

1. This radial structure is particularly observable in the Sea-urchins (*Echinoidea*), whose tests, of marvellous beauty and variety of form, are, when living, covered with rows of movable spines, which serve as defences, and aid the ambulacral tubes or suckers in locomotion. The spines, which are calcareous, vary greatly in length and form, being often very minute, but sometimes of great thickness, or of extraordinary length. (Many examples of these are exhibited.) Some of the largest of the fossil Sea-urchins, called *Clypeaster*, are from the quarries of Mokattam, near Cairo, whence the Nummulitic Stone, used in constructing the Pyramids, was quarried (Wall-case 15). The Echinoderms of our own Chalk and Oolite are placed in Table-cases 76–78.

2. Of the Star-fishes the magnificent series of *Goniasters* and

* These worms are called "*Tubicolar* Annelides," or Tube-worms.

Oreasters, from the Chalk; the fine *Solaster Moretonis*, from the Gerat Oolite, with thirty-three arms; and the five-rayed *Stellaster Sharpii*, from the Northampton Ironstone, deserve special notice. (Table-case 75.)

3. The "Brittle-stars," such as *Ophioderma Egertoni*, from the Lias of Lyme Regis, and others, closely resemble those now found living on our own coasts.

4. The Stone-Lilies (CRINOIDEA), so rare in our modern seas, were once exceedingly abundant in the Secondary and Palæozoic periods.

They were fixed during life to the sea-bottom by means of a flexible stalk. The body was of variable shape, but covered by calcareous plates, and surmounted by branched arms from five to ten in number.

The most striking objects of this group are the Lily-encrinites (*Entrochus liliiformis*), from the Muschelkalk of Brunswick (Wall-case 17); the Pear-encrinite (*Apiocrinus Parkinsonis*), from the Bradford Clay, of Wiltshire (Table-case 75); the beautiful *Pentacrinus Hiemeri*, from the Lias of Boll, Wurtemberg, and the *P. briareus*, from Lyme Regis, Dorset (Wall-case 16 and Table-case 74).

Placed on the wall, near the case of Lias Pentacrinites, is a fine polished slab of "Entrochal or Encrinital marble," from Derbyshire, almost entirely composed of the broken stems of *Actinocrini* (Stone-lilies), from the Carboniferous Limestone. The cases containing the older forms, from the Wenlock Limestone (U. Silurian), near Dudley, are deserving of special notice; also the fine series of N. American Carboniferous and Silurian genera (Wall-cases 17 and 18).

The curious and anomalous forms of *Cystoidea* and *Blastoidea*, from the Carboniferous and Silurian rocks, are very well represented here.

7. The *Holothuroidea*, which have no hard test, properly so called, and in which the body is vermiform, have small plates and spicules scattered through the skin. Those of *Synapta* (shaped like microscopic anchors) and of *Chirodota* (like minute wheels) have been found by washing the decomposed shales of the Carboniferous Limestone of the East of Scotland.

Narrow Gallery No. 3.—This is retained as a "Reserve Gallery" for study purposes.

Gallery C.—This is the third of the wide Galleries, and is now being rapidly fitted up with Table-cases and Wall-cases similar to Galleries A and B already noticed.

When completed this Gallery is intended to receive along its Western side:—

Division E. CŒLENTERATA.

Class 1. ACTINOZOA (Rayed animals).
,, 2. HYDROZOA (Hydroid ,,).

Comprising the Fossil Corals and Hydrozoa, in which latter Class are placed the GRAPTOLITES.

Division F. Protozoa.

Class 1. Spongida.
,, 2. Radiolaria.
,, 3. Foraminifera.

The Fossil Sponges form a large and important group, and were numerously represented in the Cretaceous and Oolitic rocks; the latter being chiefly from foreign localities.

The Radiolaria and Foraminifera are mostly microscopic organisms; but the latter, by their numbers, help to form large beds known as "Nummulitic Limestone" of great thickness, and covering a vast extent of mountainous country, from England to China.

The Fossil Sponges are now being worked out in detail by Dr. G. J. Hinde, F.G.S., and the Foraminifera have been carefully catalogued by Prof. T. Rupert Jones, F.R.S.

The Eastern side of this Gallery is intended for the reception of the Fossil Plants, of which a very large collection exists.

Further information regarding this Gallery will be supplied in a later Edition of the Guide.

Narrow Gallery No. 4.—This Gallery is not yet fitted up, but it is intended to be cased along its Western side for a special Stratigraphical collection, and on its Eastern side will serve to continue the exhibited series of remains of Fossil Reptilia.

HENRY WOODWARD.

List of Large Objects, placed on separate Stands, marked by Letters upon Plan.

S.E. GALLERY.

A. The human skeleton from Guadeloupe, presented by Admiral Cochrane, R.N.

B. Skull and lower jaw of *Dinotherium giganteum*, from the Miocene of Epplesheim, Hesse-Darmstadt. The jaw is a reproduction.

C. Skull of *Mastodon Andium;* from Chile, South America.

D. Entire skeleton (partly restored) of *Mastodon Ohioticus;* Kentucky, and reproduction of skull of young *Mastodon* on same stand, from New Jersey.

E. Skull of *Elephas ganesa;* from the Miocene, Sewalik Hills.

F. Skull and lower jaw of *Elephas primigenius*, from the Pleistocene Brick-earth, Valley of the Thames, Ilford, Essex.

G. A very large skull of *Elephas hysudricus*, from the Sewalik Hills, India. (Figured in the Fauna and Antiqua Sivalensis, Pl. 4.)

H. Another skull of the same species, placed so as to show the palate and the upper molar teeth; from the same locality. (*op. cit.* Pl. 5.)

J. Male skeleton, with antlers, of the gigantic Irish deer *Cervus* (*Megaceros*) *hibernicus*, from Armagh, Ireland.

K. Female (hornless) skeleton of same.

L. Restored model of *Glyptodon*, from the Pleistocene deposits of Buenos Ayres, South America (prepared from actual specimens preserved in the Museum of Natural History in Paris).

PAVILION.

M. Restored model from actual bones of skeleton of the "gigantic Ground Sloth" *Megatherium*, from Buenos Ayres. (See also Wall-case No. 12.)

N. Skeleton of *Dinornis maximus*, the largest Moa from New Zealand, and of *Dinornis parvus*, the smallest of wingless Running birds (save the *Apteryx*).

O. Skeleton of the Elephant-footed Moa (*Dinornis elephantopus*), from New Zealand.

CORRIDOR.

P. Reproduction of the great *Plesiosaurus Cramptoni.* The original, from the Lias (Alum shale) of Whitby, Yorkshire, is preserved in the Science and Art Museum, Dublin.

Q. A large crushed head of *Ichthyosaurus*, from the Lias of Lyme Regis.

R. Head of *Ichthyosaurus platyodon*, Lias, Lyme Regis, presented by F. Seymour Haden, Esq.

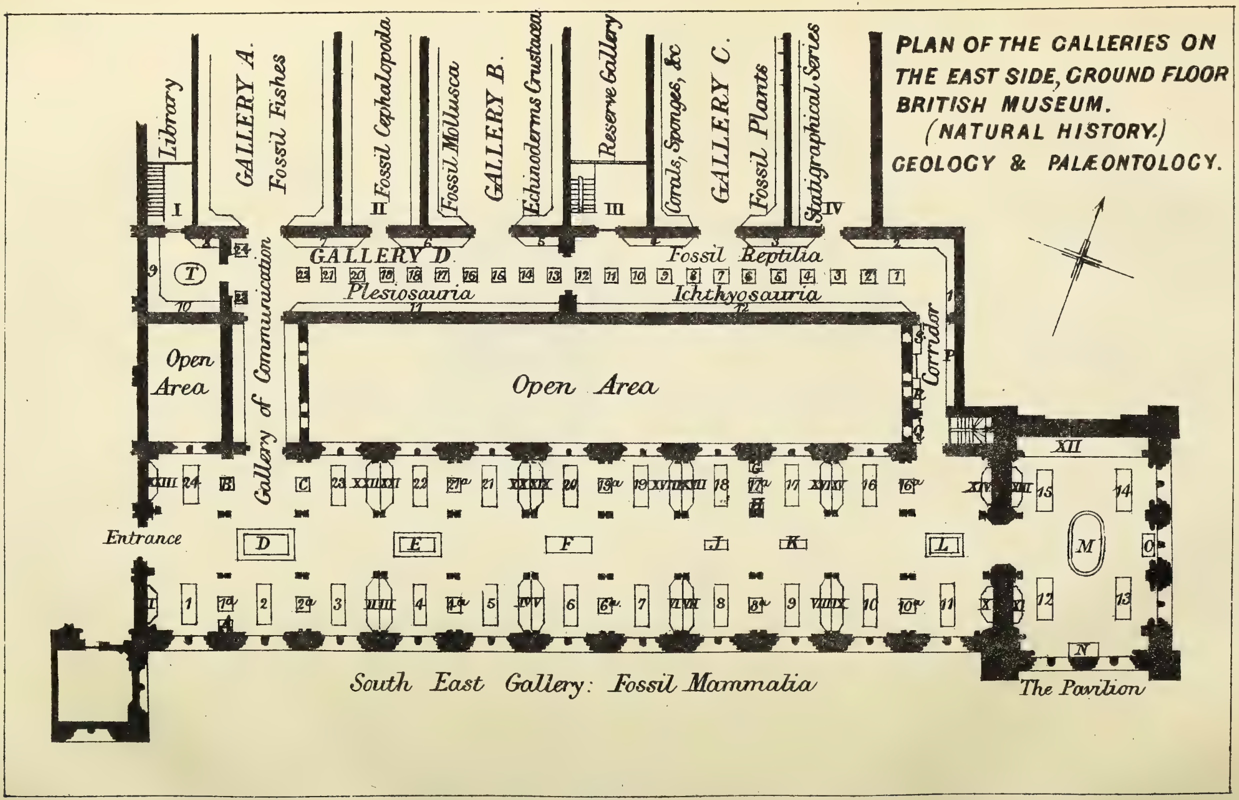
S. Reproduction of a very large skull and lower jaw of *Ichthyosaurus;* the original in the apartments of the Geological Society of London, Burlington House.

GALLERY D.

T. Restored model of Carapace of the gigantic land-Tortoise *Colossochelys gigas*, Falconer, from the Sewalik Hills, India.

GALLERY OF COMMUNICATION.

A Glass Case in this Gallery contains the remains of several huge Dinosaurs (Land-reptiles) from the Wealden of Brixton, Isle of Wight.



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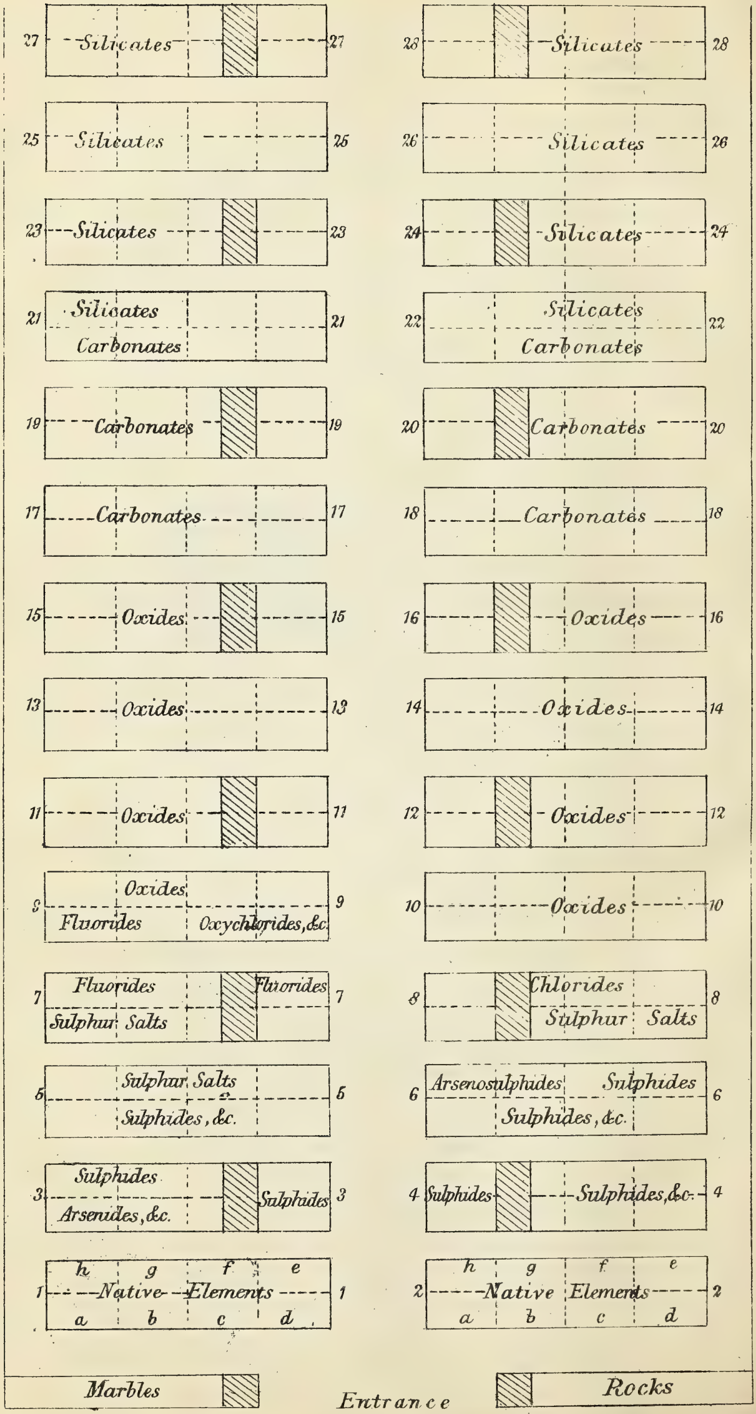
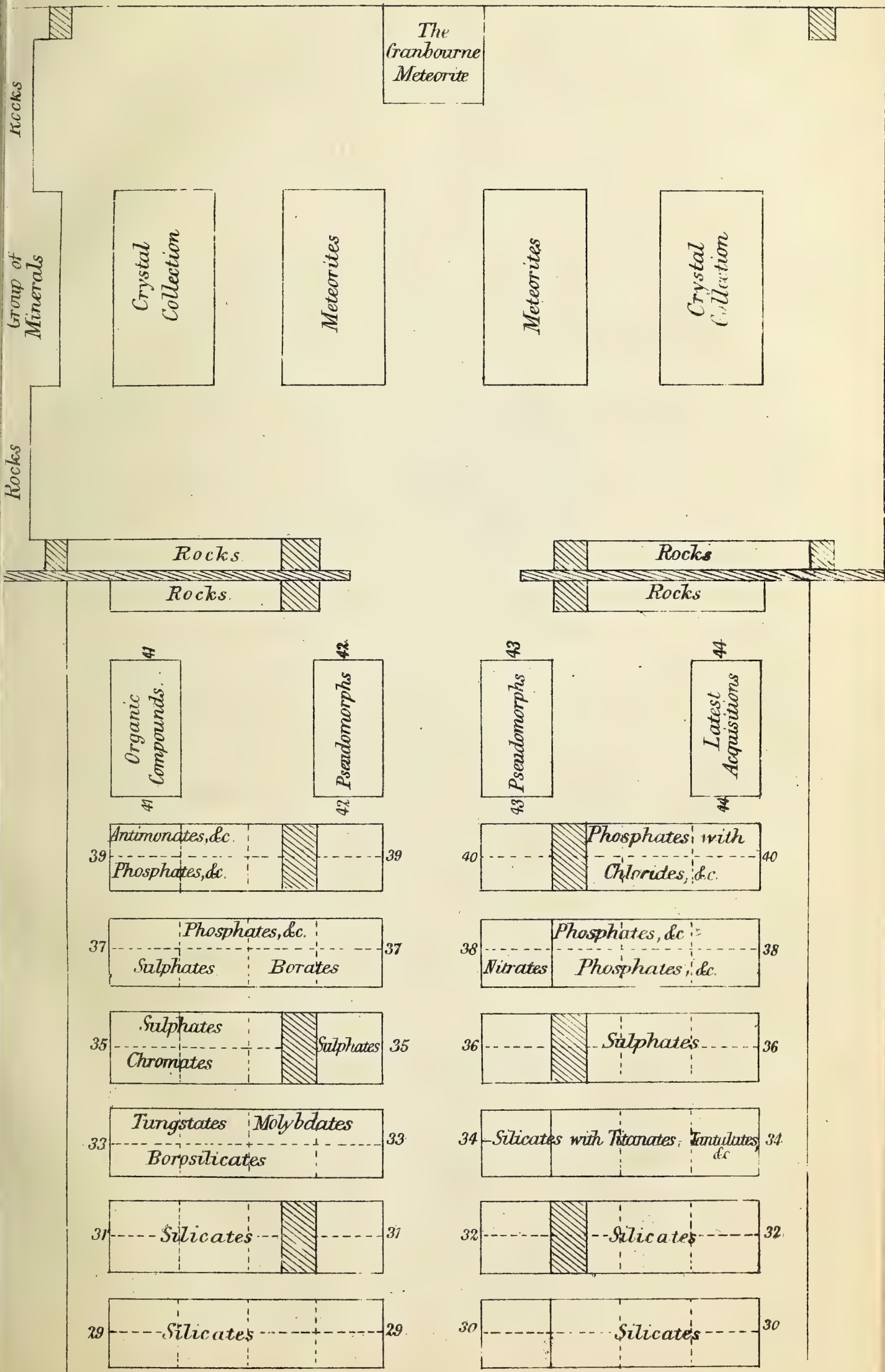

27 Silicates 27
28 Silicates 28
25 Silicates 25
26 Silicates 26
23 Silicates 23
24 Silicates 24
21 Silicates Carbonates 21
22 Silicates Carbonates 22
19 Carbonates 19
20 Carbonates 20
17 Carbonates 17
18 Carbonates 18
15 Oxides 15
16 Oxides 16
13 Oxides 13
14 Oxides 14
11 Oxides 11
12 Oxides 12
9 Oxides Fluorides Oxychlorides, &c. 9
10 Oxides 10
7 Fluorides Fluorides Sulphur Salts 7
8 Chlorides Sulphur Salts 8
5 Sulphur Salts Sulphides, &c. 5
6 Arsenosulphides Sulphides Sulphides, &c. 6
3 Sulphides Arsenides, &c. Sulphides 3
4 Sulphides Sulphides, &c. 4
1 h g f e Native Elements a b c d 1
2 h g f e Native Elements a b c d 2
Marbles
Entrance
Rocks


The Cranbourne Meteorite
Rocks
Group of Minerals
Rocks
Crystal Collection
Meteorites
Meteorites
Crystal Collection
Rocks
Rocks
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Rocks
41 Organic Compounds 41
42 Pseudomorphs 42
43 Pseudomorphs 43
44 Latest Acquisitions 44
39 Antimonates, &c. Phosphates, &c. 39
40 Phosphates with Chlorides, &c. 40
37 Phosphates, &c. Sulphates Borates 37
38 Phosphates, &c Nitrates Phosphates, &c. 38
35 Sulphates Chromates Sulphates 35
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33 Tungstates Molybdates Borosilicates 33
34 Silicates with Titanates, Tantalates, &c 34
31 Silicates 31
32 Silicates 32
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DEPARTMENT OF MINERALOGY.

INTRODUCTION.

WHILE the Biological Sciences deal with the forms of life that have existed or still exist on the globe, it is the province of Geology to trace and correlate in historical sequence the physical changes that the earth's crust has undergone under the influence of volcanic forces and the strains resulting from the contraction of the globe, as well as of the not less potent agency of water in its various phases of rain and river, sea and ice. The mineralogist, on the other hand, deals with the nature and characteristics of the materials that undergo these changes. It is for him to investigate, to discriminate, and to classify the separate substances that are mingled and massed together to form a rock, or that in an isolated condition may be met with in cavities or veins, or as transported bodies. Substances of this kind, which, when isolated, are homogeneous and definite in their composition and character, are *minerals*. In a block of granite the separate minerals that are mingled to form its mass are quartz, felspar, and mica, and they are usually distinctly visible and recognisable side by side: in rocks of finer grain, however, the discrimination is not so simple, and requires the aid of a lens or microscope. The result of the study of rocks, and of their component minerals, has been to show that the great mass of the earth's crust is formed of aggregations of minerals belonging to a very small number of the types that have been determined by the mineralogist. Introduction.

The minerals, on the other hand, that occur either as occasional or as habitual rock constituents, present the great variety, and, when arranged, the logical sequence which give to a mineralogical collection its many-sided interest. For the complete study of a mineral the mineralogist has to look beyond its merely physical aspect and character;

for these individual substances, when submitted to a further analysis, are shown by the chemist to be composed of *elements*, not mingled as are the minerals in a rock, but united according to the laws of chemical combination. Furthermore, in common with the products of chemical processes, minerals very usually present themselves in more or less symmetrical polyhedra, at times eminently complex, yet always fashioned in obedience to a geometry at once simple, exact, and universal. Such minerals are said to be *crystallised*, and the investigation of the geometrical law which all crystals obey, the determination of the character of the symmetry of each particular crystallised mineral, the accurate measurement of the angles between the faces, and thus the assignation of the specific geometrical character and crystallographical constants of every such mineral, are among the preliminary duties of the mineralogist.

Mineralogy is thus a science which deals with the description of the chemically distinct substances which form the material of the globe; its task, however, also extends to the classification of these compounds. When, with the latter view, it is attempted to assign to a certain mineral species those minerals which present at once identity in chemical composition and crystalline form, other minerals force themselves on the attention which, though corresponding very closely in their crystallographic features and constants, yet present considerable diversity in chemical composition. Many of these anomalies are explained by the principle termed *isomorphism*, according to which different elements belonging to the same chemical group may replace each other and play a similar part in the compound; that is to say, a mineral may contain one or another, or several different members of the same group of elements, provided that the chemical type as expressed by a general chemical formula remains the same; and in such cases it is usually found that the character of the crystalline symmetry is the same for all the minerals of the group, the crystallographic constants themselves differing in only a minute degree. An excellent example of this diversity of composition in minerals belonging to the same group and having the same crystalline form is presented by the Garnets, which crystallise in the Cubic system and have an identical development of crystal. The typical formula of this group is ($3\ M''O,\ M_2'''O_3,\ 3\ SiO_2$), where M'' represents an atom of Calcium, Magnesium, Iron, or Manganese, and M''' an atom of Aluminium, Iron, or Chromium; the principal subdivisions are:—

Grossularite .	$3\ CaO,\ Al_2O_3,\ 3\ SiO_2$
Pyrope . .	$3\ MgO,\ Al_2O_3,\ 3\ SiO_2$
Almandine . .	$3\ FeO,\ Al_2O_3,\ 3\ SiO_2$
Spessartite . .	$3\ MnO,\ Al_2O_3,\ 3\ SiO_2$
Andradite . .	$3\ CaO,\ Fe_2O_3,\ 3\ SiO_2$
Uwarowite . .	$3\ CaO,\ Cr_2O_3,\ 3\ SiO_2$

and thus present great variations of chemical composition, though the type remains constant. Garnets, however, are rarely found to illustrate any separate subdivision, the usual composition being that of a mixture of two or more of them together in indefinite proportions.

Again, while minerals differing very much in chemical composition may present almost exactly the same crystalline form, on the other hand, many minerals having the same percentage chemical composition present a quite different type of symmetry in the development of their crystals. Thus, to take a well-known instance, the carbonate of lime, having a composition represented by the formula $CaCO_3$, occurs in two quite distinct crystalline forms, sometimes appearing as calcite in crystals belonging to a system with trigonal symmetry, sometimes as aragonite in crystals developed according to an orthosymmetrical type.

A mineral collection, then, to be complete, must present all the different varieties of chemical composition, and at the same time illustrate the often very extensive varieties of crystalline form assumed by the minerals of a species or group. But besides these chemical and morphological features other important characters have to be illustrated, among which are the various modes of occurrence of a particular mineral, including its associations with other minerals; and in a great national collection that is to illustrate the mineralogy of the world, it is important that there be specimens from all localities where the mineral occurs under special and noteworthy circumstances; and it must be a special object that examples of each mineral species should show its most complete development, whether in magnitude or perfection of crystals, in the colour and limpid purity, or in any other important quality which may belong to it in its more exceptional occurrence.

In a mineral collection formed and arranged with these purposes in view, will be found materials of the greatest interest for science, and alike for the useful and ornamental arts: to the crystallographer, it offers some of the best illustrations of a most beautiful geometrical science; to the physicist, it provides the material on which some of the most refined and important investigations have been and may be made in connection with the theories of light, heat, magnetism, and electricity; and to the geologist, its petrological department presents the means for discriminating those minerals, of which, though they are often only recognisable under the microscope, the largest portion of the earth's crust is formed.

Here will be found, in all their variety, beauty and association, the minerals which, under the name of *ores*, furnish the metals so essential to the needs and happiness of man; here also are specimens of the numerous minerals which, whether immediately or as the sources from which manufacturers derive important products, are employed in the multifarious purposes of daily life. The suggestion that materials for construction and architectural ornament, for pigments, mordants and bleaching processes, that the phosphates for manures, the alkalies, and the materials for the manufacture of acids, are all largely dependent on the mineral resources of the world, will sufficiently show how intimately a complete mineral collection is connected with the arts and with commerce. An illustration of the importance of a single mineral is afforded by calcite or carbonate of lime: as the almost ubiquitous limestone, it supplies in some of its varieties the building materials of our cities, and when burnt gives quicklime, and in some of its impurer forms hydraulic cement; while in other varieties it presents itself as the white and spotless material used for statuary marble; or, again, beautifully and finely coloured, forms the infinitely varied ornamental marbles: sometimes it appears as calc spar in a thousand crystallographic forms which it takes the skill of a crystallographer to reduce to a common symmetry; or, again, as in one locality in Iceland, it occurs in large masses of limpid crystal, conspicuous for its double refraction, and for the invaluable means which, in the hands of Bartholinus, Huyghens and Fresnel, it has thereby afforded for the investigation of the properties of light; or, again, in its softer form of chalk, it subserves many a domestic use.

Here also are to be found rough and cut specimens of the precious stones, among which may be mentioned the Diamond, a crystallised form of the element Carbon; the Balas ruby and the Spinel ruby, a compound of alumina and magnesia; the Chrysoberyl and Alexandrite, a combination of alumina and glucina; the Sapphire and Ruby, the sesquioxide of aluminium; the Hyacinth and Jargoon, a compound of silica and zirconia; the Amethyst, Sard, Plasma, Prase, Chalcedony, and Noble Opal, which are varieties of silica or quartz; the Chrysolite and Peridot, a silicate of magnesia and iron; the Garnet with a varied composition as above mentioned; the Beryl, Emerald and Euclase, compound silicates of aluminium and glucinum; the Tourmaline and Rubellite, a borosilicate of several bases; the Lapis-Lazuli, a complex combination of silicate and sulphate; and the Turquoise, a hydrated phosphate of aluminium.

Nor from the list of the interesting contributions of a mineral collection should be omitted the series of meteoric bodies which have come to this earth from the regions of space. These strange masses of metallic iron, more or less rich in nickel, or of stone impregnated with the same metallic material, serve as witnesses that the same laws of chemical combination and of crystallographic symmetry, and the same elements, of which our own world is built up, pervade the regions of space through which these masses of matter have wandered swiftly till, entangled in our atmosphere, their course has been arrested and they have fallen to the earth with startling accompaniments of explosion, fusion, and dissipation of their material, as a consequence of the enormous temperature for which they have exchanged an often more than planetary velocity.

THE GENERAL COLLECTION.

THE General Collection is contained in a series of table-cases numbered from 1 to 41, commencing at the entrance to the gallery: the relative positions of these cases will be clear from the accompanying plan, which further shows that the specimens are arranged as if each pair of opposite cases formed a single large case extending across the gallery. Most of the larger specimens are shown in the glazed ends of the table-cases, and in general are of the same species as the smaller specimens displayed in the tops above them. An alphabetical index of the names and synonyms of all the species and varieties with references to the table-cases in which they are exhibited is given in pages 92–114; for greater precision in the statement of the position of a mineral in the collection every table-case has been divided into eight compartments represented by the letters a, b, c, d, e, f, g, h. Arrangement.

Besides the General Collection are exhibited a series of Pseudomorphs in cases 42 and 43; collections of Meteorites and of Crystals in the table-cases of the pavilion; and further, a collection of Rocks in the wall-cases of the pavilion and the gallery.

The following sketch will serve to indicate the general features of the classification of the General Collection, and, by giving the numbers of the particular table-cases, through which the principal divisions, sections, &c., are distributed, it will serve as a guide for finding any particular Minerals. The names of the species, as well as of important varieties, will be found within the table-cases, associated with the Minerals to which they belong. Classification.

The Collection of Minerals is arranged in five principal Divisions. These are—

DIVISION I. The Native Elements. Cases 1 and 2.

DIVISION II. The Compounds of Metals, with

(i.) Elements of the Arsenic group (the Arsenoids, viz., Bismuth, Antimony and Arsenic). Case 3a, b, c.

(ii.) Elements of the Sulphur group (the Thionids, viz., Tellurium, Selenium and Sulphur). Cases 3d to 6g.

(iii.) and (iv.) Elements of both the Arsenic and Sulphur groups. Cases 6h to 8f.

Division III. The Compounds of Metals with elements of the Chlorine Group (the Halogen elements—Iodine, Bromine, Chlorine and Fluorine). Cases 8g to 9d.

Division IV. Compounds of elements with Oxygen. Cases 10a to 40h.

Division V. Organic Compounds. Case 41.

These Divisions are again subdivided into sections and classes, the latter embracing the minerals which fall under the same general chemical denomination; as, for instance, the salts of the same acid or of a group of acids chemically and crystallographically equivalent to each other. Each class is further separated into distinct chemical series, the minerals included in any series being such as are designated by the same or equivalent typical formulæ. Subordinated to this chemical system of classification is the final distribution of the several homotypical species of each *chemical* series, into distinct *crystallographic* series, arranged according to the crystalline system to which they belong; the order of sequence of these systems being—1st, the Cubic System; 2nd, the Tetragonal or Pyramidal System; 3rd, the Orthosymmetric or Orthorhombic System; 4th, the Hexagonal or Rhombohedral System; 5th, the Monosymmetric or Oblique System; 6th, the Asymmetric or Anorthic System; and finally, Amorphous substances, that either present no crystalline forms, or the forms of which, if they be crystalline, are not determinable. In the following observations the term "group" will be reserved to connect Minerals, whether individual species, series, or classes, which present such a community of physical and other characters as imparts to them a sort of family resemblance.

Division I. The Native Elements.

In the first two cases are arranged such of the elementary forms of matter as are found occurring in nature in the uncombined state. These native elements, which form but a small proportion of those the chemist has eliminated from the Mineral Kingdom, are arranged in sections, of which the first is that of the native metals and their alloys.

i., Of the series of native metals crystallising in the cubic system the Cases
various forms of Copper, Silver, and Gold are the most important; and 1 & 2.
crystals of these metals are exhibited, remarkable for the perfection of their forms, or conspicuous for their size. The crystallised copper from

Siberia and from Lake Superior, the silver in crystals from Kongsberg and from Freiberg, the suite of specimens of gold from Merionethshire and other British localities, two unique nuggets of crystallised gold from the MacIvor Diggings, in Australia, and one from California, are especially worthy of remark. Besides these, will also be seen native foil of silver and of gold: moss-like filamentary aggregations of copper and of silver; nuggets, and washed grains of gold, and specimens of all these metals, in which a simple crystalline form, by being repeated or prolonged along particular axes has built up dendritic, ramose, capillary, and other singular kinds of structure. Among the specimens of gold and of *electrum*, or argentiferous gold rich in silver, from Transylvania, are some worthy of notice from the sharpness of their crystalline forms. Native lead from Sweden, and a crystalline nugget of platinum containing metallic iron and presenting magnetic polarity, given by H. I. H. the Grand Duke of Leuchtenberg, are exhibited in Case 2f. The rhombohedral series of metals includes an isomorphous group — the Arsenoids — namely, Arsenic, Antimony, and Bismuth, with which its crystalline form, rather than its chemical analogies, associates the rare native element Tellurium.

Next to the metals are arranged the Metalloids, a section including the carbon group and the sulphur group. In the former, elementary Carbon is illustrated in its two allotropic mineral forms: Diamond and Graphite. Of the Diamond, a large and extremely choice series of crystals is exhibited, together with models of the most famous for their size and history of the specimens of this, the hardest and most resplendent of gems. Specimens of the diamonds of South Africa are exhibited with the rocks in which they are found. Sectio Metall

Of Sulphur, the vast yellow crystals are among the most splendid of the mineral productions of the earth. The glazed end of Case 1 contains specimens belonging to this division, of extraordinary size and beauty.

Division II. Compounds of the Arsenoid and Thionid Elements.

Leaving the native elements, we enter upon minerals which are the products of the chemical combination of the elements with each other; but the transition is not an abrupt one. The alloys, or mixtures of metals of one and the same group, were associated in the first division with the metallic elements that compose them. But where metals belonging to distinct chemical groups are combined, they cannot be classed with the free elements. Such are the combinations of Arsenic, Antimony, and Bismuth with metals of other groups, and the Arsenides, Antimonides, &c. accordingly take their places as the first section of Division II. and will be found arranged in the first three compartments of Case 3.

Next in order to these are placed, as a second section of Division II., the compounds of metals with the "thionid elements;" and accordingly the Sulphides, Selenides, and Tellurides are displayed in Cases 3d to 6g.

These are succeeded by a third section of this division, namely, by minerals to form which compounds belonging to each of the former sections are combined together.

These three sections may be severally represented by their prominent members, the arsenides, the sulphides, and the arseno-sulphides.

Besides the three sections already mentioned, this division contains a fourth, wherein metallic sulphides are so combined with sulphides of Arsenic, Tin, Iron, &c., as to produce a series of sulphur salts, in the constitution of which Sulphur plays the part which Oxygen plays in the ordinary oxygen-salts.

ction i., senides, — The first of these sections comprises the cuprous arsenides, such as Domeykite, the tricuprous arsenide; also, the antimonide of Silver or Dyscrasite, diargentous antimonide. Besides these there are included in this section several compounds of Iron, Cobalt, and Nickel. Nickeline, called also "Copper Nickel," from its colour, is a rhombohedral mineral, the nickel arsenide. Chloanthite is the nickel diarsenide and Smaltine, or "tin-white Cobalt," the cobalt diarsenide, of which Safflorite is a variety containing Iron in place of a part of its Cobalt. These minerals are cubic in crystallisation, but some of the same substances which constitute them are also found in orthorhombic forms, affording examples of dimorphism. Thus the nickel diarsenide, when thus occurring in crystals of the orthorhombic system, is the mineral Chloanthite, and Leucopyrite is a corresponding iron diarsenide. In this section is also included the cobalt triarsenide, Skutterudite. — Cases 3 & 4.

ction ii., lphides,) Monophides, — The second section includes the various compounds of Sulphur, Selenium, or Tellurium—the Thionid elements—with the metals. Silver, a monad element, and Copper, a metal that in one group of its salts plays the part of a monad element, contribute to form a small group in this section of the type $M_2 \Sigma$. Eucairite is a selenide of Silver and Copper, and Crookesite is a selenide of Copper and Thallium. Hessite is a telluride of Silver, Naumannite the corresponding selenide of Silver, while Argentite is the sulphide of Silver. The latter are cubic in crystallisation, but the silver sulphide is a dimorphous mineral presenting itself as Akanthite in forms belonging to the orthorhombic system. To this system belongs also Copper-glance, a valuable ore of Copper, the "cuprous" sulphide. Among the other important minerals in this section, a cubic series of monosulphides occurs which includes two commercially very important ores—Galena, the sulphide of lead, and Blende, the sulphide of zinc.

A Rhombohedral series includes Covelline, the cupric sulphide, Cinnabar, or mercuric sulphide, the unique ore of the important metal Mercury. Millerite is the nickel monosulphide, and Greenockite, a rare mineral in bright yellow crystals, consists of the corresponding cadmium sulphide. — Cases 5 & 6.

.) Disulides, &c. — There is also an important series of disulphides wherein Hauerite and Iron-pyrites, which are respectively the persulphide of manganese and of iron, are cubic, while as Marcasite the latter compound is orthorhombic in crystallisation. These two forms of iron persulphide are frequent and familiar minerals, Iron-pyrites being conspicuous for its sharply defined forms, and Marcasite, or "White Iron-pyrites," for the fantastic groupings in its crystallisation that have obtained for it the various names of Spear pyrites, Cockscomb pyrites, &c.

Molybdenite (MoS_2) and Realgar (As_2S_2) are severally molybdenum and arsenic disulphides; the former a rhombohedral, the latter an oblique mineral.

Here also is included Laurite, the rare ruthenium sulphide.

(c.) Trisu phides, &

Among the trisulphides we find some important compounds of the triad elements crystallising in the orthorhombic system. They are Orpiment, or arsenic trisulphide (As_2S_3), and the two isomorphous trisulphides of Antimony and Bismuth, Bismuthite (Bi_2S_3) and Antimonite (Sb_2S_3). Of both the last minerals, and in particular of Antimonite, very fine specimens are in this table-case. Antimonite is an important source of the metal Antimony.

Section ii Arseno-s phides, &

The third section of the division is composed of minerals wherein certain arsenides, &c., of Section i. are combined with sulphides of Section ii., or which may be looked on as the result of a replacement of half the Arsenic of the minerals in the former section by its equivalent of Sulphur. Of these there is a cubic series, including Cobaltine, or Cobalt-glance, the "Silver White Cobalt" of early mineralogists, a Cobalt Sulphide with part of the Sulphur replaced by Arsenic and part of the Cobalt by Iron $\left\{ (Co,Fe)(S,As)_2 \right\}$. In Gersdorfite or Arsenical Nickel-glance, half the Sulphur is replaced by Arsenic, and in Ullmannite or Antimonial Nickel-glance by Antimony and Arsenic.

In this section, also, the minerals of this chemical type exhibit a dimorphism similar to that of Pyrites and Marcasite among the disulphides of Section ii., and of Rammelsbergite and Chloanthite among the diarsenides of Section i.; for in Mispickel and Glaucodote we find arseno-sulphides of Iron and of Cobalt with Iron of the same chemical type as Cobalt-glance, but crystallised in the orthorhombic system. Thus the three homotypic series of cubic diarsenides, disulphides, and diarsenosulphides belonging to the three sections of this division might be treated as a single group, while the three corresponding orthosymmetric series may be looked on as another such group.

Section iv Sulphur-Salts.

To the fourth section are assigned minerals wherein metallic sulphides are so combined with sulphides of Arsenic, Tin, Iron, &c., as to produce a series of sulphur-salts, in the constitution of which Sulphur plays the part which Oxygen plays in the ordinary oxygen-salts. This section is a numerous one in point of species, and the following are a few minerals included in it that are especially worthy of note.

In one (and that a somewhat ambiguous) class of these Salts, Iron, either as an iron sesquisulphide (Fe_2S_3) or an iron persulphide ($Fe\ S_2$), would seem to enter as a constituent of the "acid" ingredient. In this class we meet with two important copper ores, the largely worked Chalco-pyrites or Copper-pyrites, and Erubescite or Purple Copper-ore.

Of both these minerals, there are crystallised specimens from Cornwall; and massive pieces from Tuscany are seen in the glazed ends of Cases 5 and 6.

The rare mineral, Sternbergite, consisting of Iron, Sulphur, and Silver, belongs also to this class; while Linnæite, or "Cobalt-pyrites," (Co_2S_3, CoS,) is a sulphur-compound of Cobalt, exactly analogous to the oxygen-compounds termed the "magnetic oxides" of Iron or Manganese. Tin-pyrites is a dibasic cuprous sulphostannate, containing Iron and Zinc.

The largest class of the sulphur salts is that consisting of sulph- Cases
arsenites, sulpho-bismuthites, and sulph-antimonites. Among these 7 & 8.
Tetrahedrite (Fahlerz or Grey Copper ore) is noticeable as a most important ore of Copper. It is a tetra-basic sulph-antimonite of that metal, in which the copper is frequently replaced by small quantities of silver, and is also associated with sulphides of Iron and Zinc. In some of its varieties, as in Tennantite, the Antimony trisulphide is entirely, and in others partially, replaced by an equivalent of Arsenic trisulphide. The argentiferous Tetrahedrite is a valuable ore of Silver. Remarkable specimens of Bournonite, a tri-basic sulph-antimonite of Copper and Lead from the Herod's-foot mine in Cornwall, are here in juxtaposition with those from the Hartz, and from Traversella. The so-called Red Silvers, a group of isomorphous rhombohedral minerals, are the tri-basic sulphantimonite and sulpharsenite of Silver, Pyrargyrite and Proustite; sometimes in a comparatively isolated state, but more frequently blended together in various proportions. Beautiful as well for their forms as for their blood-red colours, that are deeper in tint according as the antimony preponderates over arsenic, they constitute one of the more precious of the ores of Silver. The specimens of Pyrargyrite and Proustite exhibited in Case 8, and in particular those of the latter mineral from Chili, are extremely fine.

Among these a large mass of resplendent crystals, of a rich ruby colour by transmitted light, was presented by the late H. Ludlam, Esq., and is a unique specimen.

Among the rarer minerals, attention may be called to the fine specimens of a variety of Freieslebenite, from Hiendelencina, in Spain; also to Fireblende and Xanthocone, the latter containing a tri-basic sulpharsenate and sulpharsenite of Silver; and to the series of minerals from the Binnenthal, including very fine crystals of Jordanite.

Division III. Compounds of the Halogen Elements.

This next principal division of the Collection is also subdivided into the simpler compounds, and a more complex section of Salts. Among the former will rank Calomel, Salammoniac, Common Salt (Sodium chloride), and Sylvine, the corresponding potassium chloride, the two latter being crystallised in large cubes and cubo-octahedra. With these are arranged the chloride, iodide and bromide of Silver, and the mixtures of these *inter se* which are kept secluded from the light. The crystal forms and colour suite of Fluor spar exhibited in Cases 7 and 8, and in the glazed ends of 9 and 10, form a series as remarkable for beauty as any in the Collection.

Cases 9 & 10. The Salts in the second section are represented by certain double fluorides, of which the most important is the Greenland mineral Cryolite (sodium aluminium fluoride), represented by some excellent specimens in its crystallised form. Section Complex chlorides, &c.

Division IV. Compounds of Oxygen.

The remaining division consists of Minerals of which *Oxygen is a constituent ingredient*, a class necessarily large on a planet with an atmosphere consisting in considerable proportion of this chemically energetic element. The rocks which constitute the earth's crust are aggregates of minerals falling under this chemical division. Here, as in the previous divisions, we distinguish the more simple kinds of combination from the more complex; and though such a distinction as is expressed by a section of oxides and a section of salts is a difficult one to define with logical precision, it yet serves the object sought in a system of classification, by bringing together compounds that most closely resemble each other, the different classes falling into a natural sequence, nearly in the order of the simplicity of their chemical formulæ.

The first section of this chemical division, the Oxides, will be found arranged in Cases 10 to 15, those containing the greater proportion of oxygen following after those that contain fewer. Commencing with basic types of oxides, we pass through certain comparatively neutral oxides (among which we must look for those members of the section which possess the most equivocal claim to a place in this section); and we then come to the higher oxides which act the part of acids in combining with bases. Section Oxides.

At the beginning of this section are placed the minerals in which oxides or hydrates are combined with chlorides or fluorides, &c. The lead-oxychlorides, Matlockite and Mendipite, are arranged here with Atacamite, a hydrate, combined with cupric chloride, and of Percylite, a beautiful mineral, of which one specimen, of uncertain locality, is associated with Gold. It is a hydrated combination of the oxychlorides of Lead and Copper.

The oxides include several very important minerals. First in order among them is Cuprite, the red oxide of Copper, cuprous oxide. It occurs in ruby-coloured and transparent crystals of the cubic system. These are seen in Case 10a, and with them are the "Tile ore," from Siberia, and the bright-red capillary deposits of Chalcotrichite from the Fowey Consols Mines, Cornwall. The cupric oxide, as Melaconite and Tenorite, succeeds to the crystalline oxides of Magnesium (Periclase), and of Zinc (red oxide of Zinc, or Zincite), in the other half of this Case. These are followed by the hydrated monoxides, including Brucite, the hydrate of Magnesium, which presents delicate hexagonal transparent crystals. (*a.*) Mo[no]oxides.

Epitritoxides. The next class in the section of oxides is composed of minerals of a chemical type, similar to that of the magnetic oxide of Iron (the ferrous-ferric oxide), which may in fact be viewed as a combination of ferrous oxide with ferric oxide, and thus, while possessing as an epitritoxide the formula M_3O_4 and a place in the section of the oxides, has claims to be recognised as a salt.

The group of cubic-formed minerals to which Magnetite more especially belongs, the "Spinel Group," includes Franklinite and Chromite (Chromic-iron), which latter mineral is the source of the chrome yellow and of some other colouring matters employed in the arts. The Spinels, properly so called, also belong to it. These are aluminates of Magnesium, also of Zinc, Iron, and Manganese; ferric oxide, too, occasionally plays the part of alumina. The deep-red "Spinel Ruby" and the pale rose-tinted "Balas Ruby" are beautiful gems cut from specimens of this Mineral, of which a good assortment of crystals is exhibited. Pleonast, Gahnite, Dysluite, are opaque varieties of Spinel.

To this class also may be referred the Chrysoberyl, a combination of glucina and alumina (aluminate of Glucinum), homotypic with epitritoxides. It is prismatic in crystallisation, and as a gem, known by the name of "oriental chrysolite," it presents itself as a beautiful greenish-yellow stone, almost equal in lustre and in hardness to the Sapphire. It also has the name Cymophane, from a cloudy appearance that presents itself in two of the planes of the crystal, and is retained even when the transparent stone is cut and polished. Cut *en cabochon*, the less transparent specimens furnish one of the kinds of stone to which the jewellers give the name of Cat's-eye. The dark green variety from the emerald mines of the Ural exhibits trichroism, absorbing the different colours in different amounts according to the crystallographic direction the light pursues on entering the crystal. Of the dark green variety, termed Alexandrite, very fine specimens are seen in Case 9e. It is amethyst-coloured by artificial light.

Sesquioxides. The next class among the oxides is that of the sesquioxides. The pure oxide of Aluminium is seen in colourless crystals of Corundum, consisting for the most part of hexagonal pyramids and prisms. With minute traces of colouring ingredients, these crystals assume rich hues, and when transparent become gems conspicuous for their extensive colour-suite, that rank next in value, as in lustre and hardness, to the diamond. These are the colourless Lux Sapphire, the (azure) Sapphire, the Ruby, the "Oriental-Topaz," "Oriental-Amethyst," "Oriental-Emerald," &c.; gems not to be confounded with those from which they borrow their names, while distinguished from these by their title "Oriental," in allusion to the Eastern lands, India, Ceylon, Siam, Pegu, &c., which from the earliest times have produced the gem forms of this mineral in their greatest perfection. In the "Star stones" a six-rayed star is seen, of which the position is symmetrical in respect to the morphological axis of the crystal; and through the less pure varieties of Corundum, we descend to the opaque and granular, massive, but still, from their hardness, valuable states of this mineral, of which Emery is an impure form. Cases 11 & 12. Identical in chemical and crystallographic type with Corundum, though very different in aspect both in its crystalline and massive varieties, is the valuable iron ore, Hæmatite, the ferric oxide. A tarnish on some of its crystals, especially on those from Elba, produces an iridescent effect of great beauty. With Hæmatite is placed Ilmenite, or Titanic-iron, one of the ambiguous species of this class. Intimately blended with the former mineral in all proportions and crystallising in its forms, it yet presents the formula of titanate of Iron, a formula, however, which, as containing two equivalents of metal united to three of oxygen, is in fact homotypic with a sesquioxide.

The hydrates of this class include the important iron ore Limonite (Brown-hæmatite), and Gœthite, which is monohydrated ferric oxide, the latter represented by fine specimens from the Restormel mine, Cornwall. Next follow Manganite and Diaspore, respectively the monohydrated manganese and aluminium oxides, isomorphous with Gœthite.

(*d*) Diox[ides]. The class of dioxides is illustrated by a series of crystals and other forms,—especially rich in the Cornish varieties—of Cassiterite or Tin-stone (stannic acid), the ore of tin: and next follows the Zircon, consisting of the associated zirconic and silicic dioxides (zirconic and silicic acids). Cases 13 & 14. Its crystals, like those of Cassiterite, with which it is nearly isomorphous, are pyramidal. Its pellucid varieties are gems. The dull green is the Jargoon, while peculiar ("hyacinthine") red tints characterize the gem known as the Hyacinth or Jacynth, of which fine cut specimens are in Case 13b. The yellow and blue tints are rare, but the more pellucid and colourless zircon, from its exceptionally high refractive power, approaches even the diamond in brilliancy.

In the same continuous series is Rutile, the titanium dioxide (titanic acid), isomorphous with Zircon, and approximately so with Cassiterite. Anatase is the same substance, also in pyramidal forms, but with different parameters; while in yet a third series of forms this trimorphous titanic dioxide is to be seen as the orthorhombic mineral Brookite, of which the specimens from the Snowdon district are remarkable.

The Rhombohedral system is represented in the class of the dioxides by Quartz and its varieties.

This important mineral is silica, the oxide of silicon (silicon being an element of the carbon group). This oxide occurs in a state physically distinct from Quartz, in the Opal, which is amorphous: specimens of it will be found at the end of the crystalline series of the dioxides. Among the purer varieties of these are the Mexican Fire Opal, and the beautiful and almost exclusively Hungarian gem, the Noble Opal, conspicuous for its fascinating play of colours. Specimens of Tridymite will be seen in Case 14b; it is a crystallised form of silicic acid, with the specific gravity of opal. Its crystalline forms, however, are distinct from those of Quartz, which is the more common and more dense variety of Silica. The latter is seen in its purest form as

Quartz crystal in Case 14c. Its tinted specimens may vie in point of colour with jewels of denser substance and higher refrangibility. Among these are the lilac-hued specimens of the Amethyst, the Brazilian specimens of which, as well as of the yellow kind, show the "rippled" fracture which distinguishes them from the ordinary Quartz, with its smooth conchoidal fracture. They are further dis tinguished by their optical properties.

A series of minerals succeeds, formed by mixtures of the crystalline with the opaline silica, and of these with iron oxides and argillaceous and other impurities. They include the various kinds of Jasper and of Chalcedony, Prase, Bloodstone and Heliotrope, Hornstone, Carnelian, Cases
Sard, Plasma, while the various banded, ribbed, eyed, spotted, clouded, 15 & 16.
and other fantastically figured and coloured stones of the Agate kind, including Onyx and Sardonyx, in every gradation of translucency, illustrate the modes in which these mixed minerals occur, and often evidence the successive action of the processes that formed them.

n ii., We next enter on the section of Oxygen-Salts, the first class under
n- which is occupied by the Carbonates. The isomorphous character of the several salts of the metals Calcium, Barium, Strontium, Lead, and Magnesium, and of the corresponding iron and manganese salts with
nates. them, finds illustrations in the long array of the anhydrous carbonates which are here exhibited, crystallised severally in forms which are equivalent, or united in various proportions of admixture in the same crystal.

These carbonates are divided by their crystalline forms into two Cases
large series or groups. The first comprises those crystallising in 17 & 18.
forms on the type of Aragonite, the orthorhombic calcium carbonate. Among these are, besides Aragonite, Witherite the barium carbonate, Strontianite the strontium carbonate, and Cerussite the lead carbonate. The specimens of this last mineral and those of Witherite are especially noticeable.

The second series comprises those minerals of this chemical type that crystallise in rhombohedral forms isomorphous with those of Calcite, the rhombohedral calcium carbonate. These include the magnesium carbonate, Magnesite; zinc carbonate, Calamine; and the iron and manganese salts termed Chalybite and Rhodochroisite respectively. They include also the mixtures of these in a very considerable variety, such as Dolomite, Ankerite, Brown Spar, &c. Baryto-calcite crystallises in forms of the oblique system, and establishes the trimorphism of these minerals by exhibiting the barium and calcium carbonates crystallised in a third set of distinct crystalline forms. The crystals of Calcite here exhibited form, with two very large crystals in separate cases, a very fine series, as well for their varied forms as for the conspicuous illustrations certain of them afford of the highly double-refracting property of the crystal.

The Limestone and Dolomite rocks are formed of minerals from this Cases
series, in various massive, granular, or crystalline aggregations, the latter 19 & 20.
of which frequently form Marbles; while into the Clay-ironstone, with which the blast furnaces of Wales and Scotland have been largely

fed, spathose-iron, or Chalybite, enters as an ingredient in a high percentage.

Cases 21 & 22. Among the hydrated carbonates, and carbonates combined with hydrates, or with compounds belonging to the previous divisions, attention may be called to the green and blue copper ores, Malachite and Chessylite, of which latter a very fine series of crystals is exhibited.

Case 22d contains also fine specimens of Cromfordite, a combination of the chloride and carbonate of lead; and of Parisite, an analogous compound from the Emerald Mines of Santa Fé de Bogotá, containing the fluoride combined with the carbonates of calcium and the rare metals of the cerium group.

The Silicates, occupying no less than twelve Cases, form the next class in this section. The minerals comprised in this large, varied, and important class are arranged in series distinguished by the type of oxide that characterises the bases in the silicate. Thus the silicates corresponding to monoxide-bases (ferrous oxide, magnesia, &c.) are arrayed in one series; those the bases of which are sesqui-oxides are in another; and such as contain bases of both kinds fall into a third. The respective hydrates are comprised under the series to which the minerals of corresponding anhydrous types belong. Silicates.

The first of these series is composed of such silicates as are formed by the combination of silica with monoxides only, or in which sesqui-oxides are met with only as accidental or intrusive ingredients. The anhydrous section of this series contains, among others, the following minerals. Phenakite, the di-glucinum silicate (Be_2SiO_4), and Willemite, a zinc-silicate (Zn_2SiO_4) corresponding and isomorphous with it, represent a rhombohedral series of dibasic silicates. The specimens of Phenakite from the emerald mines of the Urals are extremely fine. In this group is placed another rhombohedral mineral, Dioptase, a hydro-cupric silicate having the analogous formula (H_2CuSiO_4).

Of the same chemical type are the minerals comprised in the Olivine group, which are orthorhombic in their forms, and include Tephroite, di-manganous silicate; Fayalite, di-ferrous silicate; with Olivine and Hyalosiderite, which are the magnesium and magnesio-ferrous silicates of the series. The Chrysolite is the name of the pale yellow gem into which the larger and clearer specimens of Olivine are occasionally cut; while the Peridot is a pistachio-green variety, of which fine crystals and cut specimens are exhibited in Case 22f. Gadolinite, a di-yttrious silicate (containing also cerium, &c.), is represented by fine crystallised specimens; and Humite, a mineral containing Fluorine, and likewise belonging to the more basic silicates, is arranged here.

Cases 23 & 24. Among the monosilicates are arranged the large series of important minerals which form the two parallel groups of the Augites and the Hornblendes. In juxtaposition with these is seen Wollastonite, the calcium monosilicate, and the anorthic minerals Rhodonite and Babingtonite, homotypic in composition, but crystallographically differing from the other members of the series. The Augitic and Hornblendic groups present two distinct crystallographic types. In

Enstatite, the magnesian, as in Bronzite a magnesio-ferrous monosilicate crystallises in the orthorhombic system, though with certain of the angles of an Augite; while in Diopside, and the other Augites, clinorhombic in crystallisation, part of the Magnesium is displaced by Calcium, and also by Iron, Manganese, or Zinc. So Anthophyllite, a magnesio-ferrous monosilicate, corresponding with Bronzite, presents orthorhombic forms with angles belonging to the type of the Hornblendes, as exemplified in Tremolite and the other members of the group, which, however, crystallise in the oblique system. Certain varieties of Jade or Nephrite are assigned to these groups, as are also different kinds of Asbestos.

The hydrated section of this series contains the Serpentines and the talcose minerals. It comprises, also, Chrysocolla, a cupric silicate hydrate; Hemimorphite, the zinc silicate hydrate; and Apophyllite, a hydrated calcio-potassium silicate, extraordinarily fine specimens of which are seen in Cases 23 and 24, and in the glazed ends of Case 25. Cases 25 & 26.

The second series in the class of the silicates consists of those of the sesquioxides. Foremost among them is the Topaz, an aluminium silicate, in which part of the silicate is replaced by an analogous fluosilicate. Many specimens of this mineral, collected by Col. de Kokscharow, are here shown. Those from the Urulga river in Siberia are singularly fine; they are of a delicate sherry-colour, but are preserved in the dark, as light speedily bleaches them.

The third series of the silicates is constituted of those in which the monoxides and sesquioxides are associated in the same mineral.

The various groups known by the general names of the Garnets, Scapolites, Idocrase, Epidote, the Felspars, the Micas, and Dichroite find their places in this series, into the hydrated section of which fall the beautiful and extensive varieties of Zeolites and Chlorites.

Among these the Garnets form a group of minerals belonging to the cubic system in which the chemical type $\left(3M''O, M_2'''O_3, 3SiO_2\right)$ remains constant, while the isomorphous elements under that type replace each other in unlimited variety. Among the familiar forms of this mineral group, the violet-tinted Almandine, and the rich red Syriam Garnet are ferrous-aluminic varieties; the yellow and hyacinthine Garnets, known as Cinnamon-stone and Essonite contain calcium and aluminium: the calcium is replaced by magnesium in the deep blood-red Bohemian Garnet and Pyrope, varieties which when cut *en cabochon* are the Carbuncle of jewellery. Idocrase, a mineral with a smaller range of chemical variation than the Garnet, is represented by a series of crystals (of pyramidal forms) of remarkable variety and perfection. Epidote is also well represented by specimens from Ala and from the Obersulzbachthal. To the Epidote group also belong the minerals Cases 27 & 28. Allanite, Zoisite, and Jadeite. To these succeed the various minerals, Phlogopite, Biotite, Muscovite, Lepidolite, &c., included in a group under the name of Mica. The group of Felspars follows, among which will be found Labradorite, with its beautiful play of colours; the Moonstone, a partially decomposed Orthoclase; a fine specimen of the Orthoclase called "Valencianite," from Mexico; also, fine specimens of Amazonite and other varieties of microcline felspar.

Cases 29 to 32. Dichroite (the Sapphire d'Eau of jewellers) is remarkable for its pleiochroism, a character due to the different degrees in which the crystal absorbs the light of different colours according to the planes of their vibration; the crystal when looked through perpendicularly to the basal face 001 is of a rich blue, perpendicularly to the faces 010 and 100 it is of a bluish white, and of a pale straw colour respectively. The Beryl includes the Emerald, and also the Aquamarine of the jewellers; it is an alumino-glucinum silicate, the Aluminium being in the Emerald apparently displaced to a minute amount by Chromium. Euclase is a mineral composed of the same elements, and containing a small quantity of water: the specimens of it from Siberia are of high interest. These are followed by hydrated silicates, including a very complete collection of the Zeolites, among which the Mesolite from India, the Scolecite from Iceland and India, and the Edingtonite from Scotland are remarkable. Here are exhibited remarkably fine specimens of Harmotome, of Stilbite, of Waluewite and Clinochlore, of Cronstedtite and Pyrosmalite: large specimens of the latter mineral are shown in a glazed end of Case 33.

Cases 33 & 34. The silicates proper are succeeded by minerals in which silicates are associated with boric-oxide or borates. Among these the Tourmalines present a rich assortment of valuable and beautiful specimens, conspicuous for crystals of Rubellite from Siberia and Ava. Two very fine specimens of the Rubellite from the latter country are seen in this Case. The one remarkable for its magnitude and form was brought from Ava by Colonel Symes, to whom it was a present from the King of Ava. The other, also a very large specimen, and of deep colour, was presented in 1869 by C. S. J. L. Guthrie, Esq. These are succeeded, in Case 34, by a class of minerals of great mineralogical interest, containing some of the rarest of the elements, and themselves of rarity; much uncertainty, however, still attaches to the chemical formulæ of several of these species. The titanates, the tantalates, and niobates, and these combined with silicates, zirconates, and stannates, thus link the silicates to the molybdates and tungstates, and these, in turn, are followed by the class of chromates and the sulphates. The suite of specimens of Perofskite, the crystals of Eudialyte, of Columbite, of Fergusonite, of Pyrrhite, and of Æschynite, and the specimens of Tscheffkinite, are especially observable for their excellence or their rarity.

Cases 35 to 40. Among the anhydrous species in the sulphates, attention may be called to the specimens of Celestine (strontium sulphate) from near Bristol and Sicily, and to the Anglesite (lead sulphate) from Derbyshire, as also from Pennsylvania and Monte Poni. Gypsum, or Selenite, the hydrated calcium sulphate, is an important mineral as yielding Plaster of Paris by the expulsion of its water. A magnificent specimen of this mineral, as remarkable for its size as for the grouping of its crystals, presented by His Royal Highness the late Prince Consort, ornaments a window in the Pavilion. It was found at Reinhard's-bruhn, Saxe-Coburg.

Adjoining these are a few minerals of the greatest rarity and interest. The crystals of Linarite are unique, and the specimens of Caledonite and Lanarkite, of Leadhillite, a lead hypotetracarbonate combined with sulphate, and of the rare mineral Connellite, are among the finest known of these British species.

The borates and the class of nitrates occupy parts of Cases 37 and 38; thence to Case 40, the Cases are occupied by the class which includes the phosphates and arsenates, in which the isomorphism of the corresponding compounds of the arsenoid element Phosphorus, and of Arsenic, is so complete that the salts of their acids cannot be well classified apart from each other. With these also the Vanadates find their place, as being isomorphous with them.

Here may be seen fine crystals of Erythrine, the beautiful cobalt arsenate (Case 38d); specimens of Haidingerite (Case 38b), and of Erinite (Case 37h); crystals of Lazulite (Case 39b); very fine suites of Calcouranite (Case 39a) and of Cuprouranite (phosphate of Copper and Uranium) (Case 39d); the beautiful blue Cornish mineral Liroconite (Case 40a); and splendid specimens of Apatite, Mimetesite, and Pyromorphite.

Division V. Organic Compounds.

In Case 41 is arranged a series of organic compounds, which as occurring in the earth with constant and definite characters, independent of organic structure, find their place in a mineral collection. Among these, Amber, in ancient times ranking in value with the gems, is here exhibited in a large series of specimens. Case 41.

Pseudomorphs.

As an addendum to the General Collection there is shown in Cases 42 and 43 an extensive and instructive series of Pseudomorphs, that is to say of minerals presenting a form not properly belonging to themselves, but to other minerals which they have succeeded in position. They illustrate the decomposing influences to which many minerals have been subjected, and they throw valuable light on the order of succession in which, and the conditions under which, particular minerals have been formed and deposited: in furnishing us with sure proofs of conversions which we can never hope to effect in the laboratory, they afford us a knowledge of facts which can be arrived at in no other way. Cases 42 & 43.

INDEX OF THE MINERAL SPECIES

WITH THEIR VARIETIES,

CONTAINED IN THE MINERALOGICAL COLLECTION.

N.B.—The names adopted for mineral species are in roman type. Other names designating varieties, or used as synonyms, are in *italics*. Where the species to which the other names are referred are within parentheses, those names indicate varieties; where the reference is made by the sign of equality, the names are synonyms. The numbers and letters refer to those on the table-cases containing the collection; the number indicates the case and the letter the compartment of the case in which the mineral will be found.

ON METEORITES.

The Collection of Meteorites will be found on the First Floor, in the Pavilion at the end of the Mineral Gallery: the smaller specimens are arranged in the two central table-cases, and the larger ones on separate stands.

The position of any Meteorite of which a name is known can be found by help of the Alphabetical Index, page 146, *and of the Catalogue, page* 133.

The Numbers refer to those in the first column of the Catalogue, pages 133–144, *and also to corresponding Numbers placed with the specimens. The Capitals refer to corresponding Letters on the Cases, and indicate the particular pane of glass behind which a portion of the original Meteorite will be found.*

Till the beginning of the present century, the fall of stones from the sky seemed an event so strange that neither scientific men nor the mass of the people could be brought to credit its possibility. Such falls are, indeed, recorded by the early writers of many nations, Hebrew, Chinese, Greek and Roman; but the witnesses of these events have been in general laughed at for their delusions: perhaps this is less to be wondered at when we remember that the witnesses of a fall have been usually few in number, unaccustomed to exact observation, and have had a common tendency towards exaggeration and superstition.

The oldest undoubted sky-stone at present known is that which, though after the Revolution removed for a time to the Library at Colmar, is once more suspended by a chain from the vault of the choir of the parish church of Ensisheim in Elsass (137 V). The following is a translated extract from a document kept in the church:—

"On the 7th of November, 1492, a singular miracle happened: for between 11 and 12 in the forenoon, with a loud crash of thunder and a lasting noise heard afar off, there fell in the town of Ensisheim a stone weighing 260 pounds. It was seen by a child to strike the ground in a field near the canton called Gisgaud, where it made a hole of more than five feet deep. It was transported to the church as a miraculous object. The noise was heard so distinctly at Lucerne, Villing, and many other places, that in each it was thought that some houses had fallen. King Maximilian, who was then at Ensisheim, had the stone carried to the castle, and after breaking off two pieces, one for the Duke Sigismund of Austria, and the other for himself, forbade further damage, finally ordering the stone to be suspended in the church."

A still older stone, of which the history goes back far beyond the seventh century, is reverenced by the Moslems as one of their holiest relics, and is preserved at Mecca built into the north-eastern corner of the wall of the Kaaba. The late Paul Partsch, for many years Keeper of the Minerals in the Imperial Museum of Vienna, considered that the meteoric origin of this stone was sufficiently proved by information which had been submitted to him.

Three French Academicians, one of whom was the afterwards renowned chemist Lavoisier, presented to the Academy in 1772 a report on the analysis of a stone said to have been seen to fall at Lucé on September 13, 1768 (143 O.). As the identity of lightning with the electric spark had been recently established by Franklin, they were in advance convinced that 'thunder-stones' existed only in the imagination; and never dreaming of the existence of a 'sky-stone' which had no relation to a 'thunder-stone,' they somewhat easily assured both themselves and the Academy that there was nothing unusual in the mineralogical character of the Lucé specimen, their opinion being that it was an ordinary stone which had been struck by lightning.

In 1794 the German philosopher Chladni, famed for his researches into the laws of sound, brought together numerous accounts of falls from the sky, and called the attention of the scientific world to the fact that several masses of iron, of which he specially mentions two, had in all probability come from outer space to this planet.

One of these is the now famous mass known as the Pallas-iron (122 K). This irregular mass, weighing 1500lbs., of which the greater part is now in the Museum at St. Petersburg, was met with at Krasnojarsk by the traveller Pallas in the year 1772, and had been found on the surface of Mount Kemirs, between Krasnojarsk and Abekansk in Siberia, in the midst of schistose mountains: it was regarded by the Tartars as a 'holy thing fallen from heaven.' The interior is composed of a ductile iron, which, though brittle at a high temperature, can be forged either cold or at a moderate heat: its large sponge-like pores are filled with an amber-coloured olivine: the texture is uniform, and the olivine equally distributed: a vitreous varnish preserved it from rust.

A second specimen referred to is that which in 1783 Don Rubin de Celis was sent to investigate; it had been found by Indians, roving across the desert to the forests beyond in search of honey and wax and trusting to rain for drink, in the Gran Chaco Gualamba, near Otumpa, in the province of Tucuman, South America (No. 2), and was at first thought to be an iron mine. Don Rubin de Celis estimated the weight of this mass of malleable iron at thirty thousand pounds, and reported that for a hundred leagues around there were neither iron mines nor mountains nor even the smallest stones, while from want of water the district was uninhabited. A specimen (weighing 1400 lbs.) of the iron of this locality is placed on a marble pedestal in the Pavilion.

Chladni argued that these masses could not have been formed in the wet way, for they had evidently been exposed to fire and slowly cooled: that the absence of scoriæ in the neighbourhood, the extremely hard and pitted crust, the ductility of the iron, and, in the case of the Siberian mass, the regular distribution of the pores and olivine, precluded the theory that they could have been formed where found, whether by man, electricity, or an accidental conflagration: he was driven to conclude that they had both been formed elsewhere and projected to the places where they were discovered; and as no volcanoes had been known to eject masses of iron, and as, moreover, no volcanoes are to be met with in those regions, he held that the specimens referred to must have actually fallen from the sky. Further, he sought to show that the fall of a heavy body from the sky was the direct cause of the luminous phenomenon known as a fire-ball.

About seven o'clock on the evening of June 16, 1794, as if to direct attention to Chladni's theory, there fell quite a shower of stones at Siena, in Tuscany (148 R). The event is described in the following letter to the Earl of Bristol, written from Siena on July 12, 1794, by Sir William Hamilton, K.B., F.R.S., at that time British Envoy-Extraordinary and Plenipotentiary at the Court of Naples :—

"In the midst of a most violent thunderstorm, about a dozen stones of various weights and dimensions fell at the feet of different persons, men, women, and children. The stones are of a quality not found in any part of the Siennese territory: they fell about 18 hours after the enormous eruption of Mount Vesuvius: which circumstance leaves a choice of difficulties in the solution of this extraordinary phenomenon. Either these stones have been generated in this igneous mass of clouds which produced such unusual thunder, or, which is equally incredible, they were thrown from Vesuvius, at a distance of at least 250 miles: judge, then, of its parabola. The philosophers here incline to the first solution. I wish much, Sir, to know your sentiments. My first objection was to the fact itself, but of this there are so many eyewitnesses it seems impossible to withstand their evidence."

Soon after there fell a stone in England itself. About three o'clock in the afternoon of December 13, 1795, a labourer working near Wold Cottage, Thwing, Yorkshire (149 Z), was terrified to see a stone fall about ten yards from where he was standing. The stone, weighing 56 lbs., was found to have gone through 12 inches of soil and 6 inches of solid chalk rock. No thunder, lightning, or luminous meteor accompanied the fall; but in the adjacent villages there was heard an explosion likened by the inhabitants to the firing of guns at sea, while in two of them the sounds were so distinct of something singular passing through the air towards Wold Cottage, that five or six people went up to see if anything extraordinary had happened to the house or grounds. No stone of the kind was known in the country.

It seemed to be now impossible for any one to doubt the fall of stones from the sky, but the reluctance of scientific men to grant an extra-terrestrial origin to them is shown by the theories referred to in the above letter of Sir W. Hamilton, and is rendered even more evident by the theory proposed in 1796 by Edward King, who suggested that the stones had their origin in the condensation of a cloud of ashes, mixed with pyritical dust and numerous particles of iron, coming from some volcano. As the stones fell at Siena from a cloud coming from the North, while Vesuvius is really to the South, he gravely suggested that in this case the cloud had been blown from the South past Siena, and had then before its condensation been brought back by a change of wind. As to the fall of a stone near Wold Cottage, he was not prepared either to believe or disbelieve the witnesses until the matter had been more closely examined; but in case the statements should prove worthy of credit, he points out the possibility of a cloud having come from Mount Hecla in Iceland.

Later came a well-authenticated account of a more wonderful event still. At 8 o'clock on the evening of December 19, 1798, many stones fell at Krakhut, 14 miles from Benares, in India (152 S); the sky was perfectly serene, not a cloud having been seen since December 11th, and none being seen for many days after. According to the observations of several Europeans, as well as natives, in different parts of the country, the fall of the stones was preceded by the appearance of a *ball of fire*, lasting for only a few instants, and accompanied by an explosion resembling thunder.

Fragments of the stones of Siena, Wold Cottage, and Benares, as also of a stone said to have fallen on July 3, 1753, at Tabor, in Bohemia (140 Q), came into the hands of Edward Howard, and the comparative results of a chemical and mineralogical investigation (the latter by the Count de Bournon) of these four stones are given in a paper read before the Royal Society on 25th February, 1802. Howard concludes as follows :—

> "The mineralogical descriptions of (the Lucé stone by) the French Academicians, of (the Ensisheim stone by) M. Barthold, and of (the above four stones by) the Count de Bournon, all exhibit a striking conformity of character common to each of these stones, and I doubt not but the similarity of component parts, especially of the malleable alloy, together with the near approach of the constituent proportions of the earth contained in each of the four stones, will establish very strong evidence in favour of the assertion that they have fallen on our globe. They have been found at places very remote from each other, and at periods also sufficiently distant. The mineralogists who have examined them agree that they have no resemblance to mineral substances properly so called, nor have they been described by mineralogical authors."

This paper stirred up much interest in the scientific world, and, though Chladni's theory that such stones came from outer space was still not accepted by it, belief therein was rendered more possible after Laplace had shown that a body shot from the moon in the direction of the earth, with an initial velocity of 7592 feet per second, would not fall back upon the moon, but would actually, after a journey of sixty-four hours, reach the earth, upon which, neglecting the resistance of the air, it would fall with a velocity of about 31,508 feet per second.

Whilst the minds of the philosophers were in this unsettled condition, there came a report that still another shower of stones had fallen, this time in France, and within easy reach of Paris. To settle the matter finally, if possible, the physicist Biot, Member of the French Academy, was directed by the Minister of the Interior to inquire into the event upon the spot. After careful investigation of the whole of the phenomenon, Biot was convinced that—

1. On Tuesday, April 26, 1803, about 1 P.M., there was a violent explosion in the neighbourhood of l'Aigle,

in the department of Orne, lasting for five or six minutes: this was heard for a distance of 75 miles round.

2. Some moments before the explosion at l'Aigle, a fire-ball in quick motion was seen from several of the adjoining towns, though not from l'Aigle itself.
3. The explosion was due to the bursting of the fire-ball.
4. There was absolutely no doubt that on this day many stones fell in the neighbourhood of l'Aigle (153 T).

Biot estimated the number of the stones at two or three thousand: they fell within an ellipse of which the larger axis was 6·2 miles, and the smaller 2·5 miles, and this inequality would indicate not a single explosion but a series of them. With the exception of a few little clouds of ordinary character, the sky was quite clear.

The exhaustive report of Biot, and the conclusive nature of his proofs, compelled the whole of the scientific world to recognize the fall of stones on the earth from outer space as an undoubted fact.

Since that date many falls have been observed, and the attendant phenomena carefully investigated. These observations teach us that *meteorites*, as they are now called, fall at all times of the day and night, and at all seasons of the year, while they favour no particular latitudes: also they are found to be quite independent of the weather, and in many cases have fallen when the sky has been perfectly clear: even where stones have fallen in what has been *called* a thunder-storm, we may reasonably suppose that the luminous phenomena have been mistaken for lightning, and the noise of the explosion for thunder.

It is found that meteorites enter the atmosphere with planetary velocities ranging from 10 to 45 miles per second. Let us attempt to follow the course of such a body. So long as the body is moving through 'empty space' the only heat it receives will be that sent direct from the sun; the meteorite will thus be probably very cold, and, from its size and want of luminosity, invisible to an observer on the earth's surface. A very speedy change must take place. Assuming the law of resistance of the air for a planetary velocity to be the same as that deduced from experiments with artillery, the astronomer Schiaparelli has shown that if a ball of 8 inches diameter and $32\frac{1}{3}$ lbs. weight enter the atmosphere with a velocity of $44\frac{3}{4}$ miles a second, its velocity on arriving at a point where the barometric pressure is still only $\frac{1}{760}$-th of that at the earth's surface will have been already reduced to $3\frac{1}{6}$ miles a second. From this it is clear that the speed of the meteorite after the whole of the atmosphere has been traversed will be extremely small, and comparable with that of an ordinary falling body. From experiments lately made by Professor A. S. Herschel, it has been calculated that the velocity of the meteorite which fell at Middlesborough, in Yorkshire (359 R), on March 14, 1881, was, on striking the ground, only 412 feet per second.

Further, Schiaparelli points out that in the case supposed, the energy already converted into heat would be sufficient to raise 198,400 pounds of water from freezing point to boiling point under the ordinary barometric pressure. The greater part of this heat is, no doubt, carried off by the air through which the meteorite passes; but still the wonder is, not that a meteorite is small on reaching the earth's surface, but that any of it is left to 'tell the tale.' This sudden generation of heat will cause a fusion and volatilisation of the surface-matter of the meteorite, and in some cases a combustion of some of its constituents: the products of this action sufficiently account for the *cloud* from which a meteorite is generally seen to emerge as also for the train often left behind. Owing to the quick reduction of speed, the luminosity will be a feature of the higher part of the course. The Orgueil meteorite of May 14, 1864 (296 Y), notwithstanding its easterly motion, was seen over a space of country ranging from the Pyrenees to the north of Paris, a distance of more than 300 miles.

Next we may remark that the time of flight in the earth's atmosphere will be very short, and reckoned only by seconds. Even in the case where the matter is so good a conductor of heat as iron, if we may judge from the time one end of a poker may be held in the hand whilst the other end is in the fire, the heat will not have had time to get far below the surface before the body has reached the ground. In fact, even with the advantage of the fresh generation of heat which takes place on the sudden stoppage by impact on the earth, meteorites are sometimes so *cold* that they cannot be handled immediately after their fall. This was the case with the Dhurmsala meteorite of July 14, 1860 (284 W).

As a matter of fact, meteorites are invariably found to be covered with a *crust* or varnish, the thinness of which shows the slight depth to which the heat has had time to penetrate. The appearance of this crust varies according to the mineral constitution of the meteorites: it is generally black as in Wold Cottage (149 Z), often a shiny black, as in Stannern (165 X), and sometimes of a grey colour, as in Durala (182 O).

In the case of the Pultusk meteorite of January 30, 1868 (313 V), several thousands of stones, varying from the size of an orange to that of a nut, were picked up, each covered with a crust. In the Museum of Stockholm there are perfect little meteorites covered with crust, which weigh no more than a single grain; they were gathered out of the snow after the Hessle fall of January 1, 1869 (322 V).

The crust is not of equal thickness over the whole of the meteorite, but, owing to the motion through the air, is generally in *ridges* and *furrows*, of which the directions indicate the position of the meteorite in regard to its line of motion at a certain part of its course; and this relation is rendered more clear by the position of the *swellings* produced by the flow of the liquid material to the back of the moving mass. Meunier grants that this crust is due to the action of heat, but considers that the action is direct, and not through fusion: he holds that only the outer surface of the crust itself has been melted and that the furrows and swellings are due to the scooping action of the air through which the meteorite at first rushes with so enormous a velocity. The Nedagolla iron (106 J) and the Goalpara stone (312 Y) illustrate this peculiarity.

Further, the surface of a meteorite is generally covered with *pittings* which have been compared to thumb-marks; the Parnallee (265 NZ), and the Pultusk (313 V) present good examples of this character. It is remarkable that pittings bearing a close resemblance to those of meteorites have been observed on the large partially burned grains of gunpowder which have been picked up near the muzzle after the firing of the 35-ton and 80-ton guns at Woolwich. The pitting of the gunpowder grains is attributed to unequal combustion, but that of meteorites seems to be due not so much to inequality of combustibility as to that of conductivity and fusibility of the matter on the surface.

The sudden generation of heat, and the consequent expansion of the outer shell, account not only for the *break-up* of the meteorite into fragments, but also for the *crash like that of thunder* which is a usual accompaniment of the fall. Haidinger was, however, inclined to refer this noise, not to the fracture, but to the sudden collapse of the vacuum which is so quickly left behind in the early part of the course. In the consideration of this question the Butsura fall of 12th May, 1861 (285 PQ), is particularly interesting. The explosions, in this case three in number, were heard 60 miles away at Goruckpur. Fragments of the stone were picked up three or four miles apart, and, wonderful to say, it was possible to reconstruct with much certainty the portion of the meteorite of which they are the part. Two of them, in other respects fitting perfectly together, are even on the faces of the junction now coated with a black crust, showing that one disruption took place when the meteorite had a high velocity; two other fragments found some miles apart fitted perfectly, and were neither of them incrusted at the surface of fracture, thus indicating another disruption at a time when the velocity of the meteorite had been so far reduced that the surface could no longer be liquefied through the generation of heat. Sometimes, as at Orgueil, the fragments reach the ground before the sound of the explosion is heard, proving that the break-up has taken place while the velocity of the meteorite was considerably higher than that of the sound vibrations (1100 feet a second).

After the explosion are generally heard sounds which have been variously likened to the flapping of the wings of wild geese, to the bellowing of oxen, to the roaring of a fire in a chimney, to the noise of a carriage on the pavement, and to the tearing of calico : these sounds are probably due to the rush of the fragments through the air in the neighbourhood of the observers.

As to the *nature of the matter* of which these meteorites are composed, about 24, and those the most common, of the 64 elements at present recognised as constituents of the earth's crust have been met with, while no new element has been discovered. The most frequent are Iron, Magnesium, Silicon, Oxygen, and Sulphur; next follow Aluminium, Calcium, Nickel, Carbon and Phosphorus; while in smaller quantity occur Hydrogen, Nitrogen, Lithium, Sodium, Potassium, Titanium, Chromium, Manganese, Cobalt, Copper, Arsenic, Antimony, Tin, and Chlorine. All of these are met with in the combined state, but some, among which may be mentioned Iron Carbon and Sulphur, are present also in the elementary condition. Of the compounds found in meteorites, the following are as yet new to terrestrial mineralogy:—*Various alloys of nickel and iron*; *Troilite*, or ferrous sulphide FeS; *Oldhamite*, or calcium sulphide CaS; *Osbornite*, a titanium-calcium sulphide; *Daubréelite*, a compound analogous to chromite, and having the formula $(Fe,Cr)_3S_4$; *Lawrencite*, or ferrous chloride; *Asmanite*, a rhombic variety of silica; *Maskelynite*, a cubic labradorite discovered by Tschermak; and different varieties of *Schreibersite*, containing phosphides of nickel and iron. Of the above, it is held by some that the troilite is identical with some varieties of terrestrial magnetic pyrites, and that the asmanite discovered by Maskelyne is the same as the terrestrial tridymite, the optical properties and the crystalline form of which, as then known, were quite different from those observed in asmanite. The other compounds observed in meteorites are found also among terrestrial minerals; they are, magnetic pyrites, magnetite, chromite, tin oxide, varieties of olivine, bronzite and augite, enstatite, anorthite, and perhaps also labradorite The investigation of the nature of the minerals of which meteorites are composed has received a great impetus through the work done upon the specimens in this Museum by the late Keeper Professor N. S. Maskelyne with the assistance of Dr. Walter Flight.

For the purpose of classification meteorites may be conveniently arranged in three groups, which pass more or less gradually into each other: the first includes all those which consist mainly of iron, and have, therefore, been called *aerosiderites* (sky-irons), or, more shortly, *siderites;* the second is formed by those which are composed of iron and stone, both in large quantity, and are called *aerosiderolites* (sky-iron-stones), or, shortly, *siderolites;* while those of the last group, being almost wholly of stone, are called *aerolites* (sky-stones).

In the aerosiderites the iron generally varies from 80 to 95 per cent., the nickel from 6 to 10 per cent.; in the Morro do Ricio iron (109 J) 34, and in that of Oktibbeha County (64 G) as much as 60 per cent. of nickel have been found: the nickel is in part at least alloyed with iron, and several of these alloys have been distinguished by special names. There are also frequently present troilite in veins or large nodules, sometimes surrounded by graphite, carbon in combination with the iron, and also schreibersite and daubréelite. Further, the researches of Berzelius, Boussingault, Graham and Mallet have proved the presence of the gases hydrogen, nitrogen and the carbonic oxides occluded in the iron; Dr. Walter Flight has lately shown that the gases occluded in the Rowton iron (110 J) would under normal temperature and pressure have a volume upwards of six times that of the meteorite itself. The want of homogeneity in meteoric iron is beautifully shown by the 'Widmanstätten' figures called into existence when a polished surface is exposed to the action of acids or bromine; they are due to the unequal action on the various constituents, and are formed by layers of schreibersite and of tænite, one of the alloys of nickel and iron; see Zacatecas (6 B), Lockport (14 C) and Seneca River (49 E).

The aerosiderites *actually observed to fall* reach only the small number of six; they are, Agram (B 1), Charlotte (27 D), Braunau (43 E), Tabarz (60 F), Nedagolla (106 J), and Rowton (110 J); besides these, there are two others, of which the dates of fall are doubtful. The remaining specimens in collections of aerosiderites are presumed to be of meteoric origin by reason of their peculiar appearance and composition, and of circumstances connected with the locality in which they have been found. The difficulty of distinguishing an iron of terrestrial from one of meteoric origin has been lately rendered more evident by the controversy as to the origin of the large masses of iron, containing one or two per cent. of nickel, and weighing 9,000, 20,000, and 50,000 lbs. respectively, found in 1870 by Professor Nordenskiöld on the beach at Ovifak, Disko Island, Western Greenland (103 L). A careful examination of the rocks of the neighbourhood shows that the basalt contains nickeliferous iron disseminated through it, and that the large masses, at first thought to be meteorites, are very probably of terrestrial origin, and have been left exposed upon the sea-shore through the weathering of the rock which originally enclosed them. Malleable metallic nodules extracted from the rock itself were found to contain as much as 6·5 per cent. of nickel. Some assert that the basalt and the nickel-iron have been expelled together from great depths below the earth's surface, while others consider that the nickel-iron is due to the reduction of the basalt in its passage through the beds of lignite and other vegetable matter found in the vicinity.

The minerals forming the stony part of the siderolites and aerolites are almost entirely crystalline, and in most cases present a peculiar 'chondritic' or granular structure, the loosely coherent grains being composed of minerals similar to those which enclose them, and containing at times minute particles of iron disseminated through them. The minerals mentioned above as occurring in meteorites are such as are very characteristic of the more basic terrestrial rocks which have been brought from considerable depths below the earth's surface. Several attempts to classify aerolites according to their mineralogical constitution have been made, but it cannot be said that any of them is very satisfactory: seeing that even in the same stone there may be much difference in its parts a perfect classification on such a basis is scarcely to be hoped for. About nine out of every ten of the stony meteorites belong to a group to which Rose has given the name of *Chondrites:* their crust is black and always dull: the fracture is grey and is rough to the touch: they present a very fine-grained but crystalline matrix or paste consisting of nickel-iron, troilite, chromite, a soluble silicate (olivine) and an insoluble silicate (approaching to augite or enstatite); through this paste are disseminated 'chondra' or little spheres of various sizes and consisting principally of the insoluble silicate: see Wold Cottage (149 Z), Parnallee (265 N,Z). Perhaps for those aerolites which contain little or no nickel-iron the division into Howardites, Eukrites, Chladnites, Chassignites, Shalkites, and Carbonaceous is the most convenient. The *Howardites* have a shiny crust, and are composed of a mixture of olivine and triclinic felspar, with a little chromite and nickel-iron: examples of these are Luotolax (176 W), Bialystock (205 W), Frankfort (320 W).

The *Eukrites* also have a shiny crust, but contain more alumina and lime and less magnesia than do the other aerolites; they consist of a mixture of augite and anorthite, with a little troilite and very little nickel-iron: as examples may be cited Juvinas (190 X), Stannern (165 X), and Jonzac (187 X).

The *Chladnites* contain bronzite or enstatite, and occasionally augite; also small quantities of nickel-iron, troilite, osbornite, chromite, with occasional oldhamite: examples are Bishopville (233 Y) and Bustee (255 Y).

The *Chassignites* consist principally of olivine rich in iron and enclosing chromite: see Chassigny (183 W) and Manegaum (235 W).

The *Shalkites* are a small-grained mixture of olivine, enstatite and chromite: see Shalka (248 X).

The *Carbonaceous* consist of olivine and enstatite, enclosing more or less of nickel-iron, sulphur, carbon, troilite, chromite and hydrocarbons. Meteorites of this class must clearly have been cold on entering the atmosphere. For specimens of carbonaceous meteorites see Alais (161 Y), Cold Bokkeveldt (225 Y), Kaba (268 Y), and Orgueil (296 Y).

The importance of the examination and classification of meteorites with a view to a possible recognition of *periodicity* of fall need only be mentioned to be appreciated: such a determination is, however, rendered very difficult by the close similarity of structure and composition presented by large groups, such as the Chondritic.

Attention has been already directed to the fact that although many meteoric irons, some of them like that of Cranbourne (No. 77) weighing several tons, have been found at various parts of the earth's surface, very few of them have been actually observed to fall: in the case of the stony meteorites just the opposite holds good, for they are never very large, and few are known which have not an authenticated date of fall. This may be due to the fact that a meteoric stone is less easily distinguished than is a meteoric iron from terrestrial stones, and will thus in most cases remain unnoticed unless actually seen to fall; while, further, a quick decomposition and disintegration must set in on exposure to atmospheric influences. The smaller size of the meteoric stones may be due to the greater ease with which they break up on the sudden increase of temperature of their outer surface consequent on their entry into the earth's atmosphere. The largest meteoric stone known is that of Knyahinya (308 O), weighing 647 lbs.; it is preserved in the Vienna Museum.

If we now examine more closely the *forms* in which the various components of the meteoric stones present themselves, it will be seen that in the large group of Chondritic aerolites the chondra or grains, of which some can only be seen under the microscope whilst others reach the size of a cherry, appear to have attained to their present form not by a process of crystallisation but by one of friction, and that the matrix or paste in which the chrondra are enclosed is apparently made up of minute splinters, probably due to the wearing down of the chondra themselves. Such aerolites bear a strong structural likeness to volcanic tuffs, and as they contain no trace of vitreous rock nor yet any distinct crystals, they are quite different in character from the volcanic lavas.

Since the time of their formation some meteoric stones, as Tadjera (310 T) appear to have been heated throughout their mass to a high temperature: and in Orvinio (V 336) and Chantonnay (174 W) fragments are cemented together with a material having the same composition, thus giving rise to a structure resembling that of a volcanic breccia. Others seem to have experienced a chemical change, for in Knyahinya (308 O) and in Mezö-Madaras (253 T) the chondra are found to be surrounded by spherical and concentric aggregations of minute particles of nickel-iron, perhaps due to the reducing action of hydrogen at a high temperature. Others, as Château-Renard (230 X), Pultusk (313 V), and Alessandria (280 P), present what in terrestrial rocks would probably be called faults: in some cases the fissures are seen to have been filled with a fused material after the spherules have been broken and one side of the fissure has glided along the other. These peculiarities of structure would indicate that the small body which reaches the earth is only a minute fragment of a much larger mass.

As to the *conditions* under which compounds such as have been mentioned as occurring in meteorites, can have been formed, we may assert that they must have been very different from those which at present obtain near the earth's surface: in fact, it is difficult to imagine that the unstable sulphides can either have been formed or have remained undecomposed under circumstances in which water and atmospheric air have played any prominent part. Still, what little we do know of the inner part of our globe does not shut out the possibility of the existence of similar compound and elementary bodies at great depths below the surface. Daubrée, after experiment, inclines to the belief that the iron is due, in many cases at least, to reduction from an olivine rich in diferrous silicates, and this view acquires some additional probability from the presence of the gases hydrogen and carbonic oxide in several meteoric irons: the existence however, of such siderolites as that of Krasnojarsk (122 K), which is still rich in ferruginous olivine and yet presents no traces of the intermediate magnesium silicate (enstatite), offers a weighty objection to the general application of this view.

We must now briefly refer to the theories which have been framed to explain the *origin* of these bodies. The old theories that they are ordinary stones struck by lightning, or carried to the sky by a whirlwind, or are concretions in the atmosphere, or are due to the condensation of a cloud coming from some volcano, or have been shot recently from terrestrial volcanoes, are all seen to be quite inconsistent with later observation. The suggestion of Laplace that they come from *modern* volcanoes of the moon, although mathematically sound, has no physical basis, for, so far as one can discover, active volcanoes do not exist: and Prof. R. S. Ball has virtually excluded the *ancient* volcanoes by pointing out that if a lunar projectile once misses the earth its chance of ever reaching it is too small to be worthy of mention. Nor is it probable that they are portions of a lost satellite of the earth or are due to a collision of two planets, for in each of these cases we should expect to have received some of the larger fragments which must at the same time have been produced. It has further been shown that, although the explosive force necessary to carry a projectile so far from one of the smaller planets that it would not return, is not very large, yet the initial velocity requisite to carry the body as far as the earth's orbit is so considerable and the chance of hitting the earth so slight that a more probable hypothesis is, to say the least, desirable. *If* these bodies have been shot from volcanoes, Mr. Ball is himself inclined, upon mechanical grounds alone, to believe that the projection took place in bygone ages from the volcanoes of our own planet; for as such a projectile, having once got away from the earth, would take up a path round the sun which would intersect that of the earth, every one of them would have a chance of some time or other meeting it again at this point of intersection and of appearing as a meteorite.

The high velocities and the peculiar motions of these bodies are, however, not consistent with any of the theories which would confine them to the solar system. Their origin must, therefore, be assigned to that convenient part of space called interstellar, of which nothing is known: if at any time a real connection can be traced between meteorites and shooting stars, we may begin to hope for a solution of this difficult problem.

To those who may wish to inquire more closely into the questions suggested by the preceding pages the following are a few of the publications which may be recommended for perusal:—

Chladni (E. F. F.)—Ueber den Ursprung der von Pallas entdeckten Eisenmasse, und einige damit in Verbindung stehende Naturerscheinungen. *Riga* und *Leipzig*, 1794.

KING (E.)—Remarks concerning stones said to have fallen from the clouds both in these days and in ancient times. *London*, 1796.

HOWARD (E.)—Experiments and observations on certain stones and metallic substances, which at different times are said to have fallen from the clouds. Transactions of the Royal Society, 25th Feb., 1802.

IZARN (J.)—Des pierres tombées du ciel, ou lithologie atmosphérique. *Paris*, 1803.

BIOT (J. B.)—Relation d'un voyage fait dans le Dép. de l'Orne, pour constater la réalité d'un météore observé à l'Aigle, le 26 Avril, 1803. Mémoires de l'Institut, 7, 1803.

BIGOT DE MOROGUES (P. M. S.)—Mémoire historique et physique sur les chutes des pierres tombées sur la surface de la terre. *Orléans*, 1812.

BUCHNER (O.)—Die Meteoriten in Sammlungen: ihre Geschichte, mineralogische und chemische Beschaffenheit. *Leipzig*, 1863.

ROSE (G.)—Beschreibung und Eintheilung der Meteoriten auf Grund der Sammlung im Mineralogischen Museum zu Berlin. *Berlin*, 1864.

RAMMELSBERG (C. F.)—Die chemische Natur der Meteoriten. *Berlin*, 1870.

MEUNIER (S.)—Cours de géologie comparée. *Paris*, 1874.

MASKELYNE (N. S.)—Some lecture-notes on meteorites. Nature, vol. xii., 1875, pp. 485, 505, 521.

TSCHERMAK (G.)—The formation of meteorites, and volcanic agency (translated from the German by Dr. Walter Flight). Lond., Edin., and Dub. Philosophical Magazine 1876, page 497.

DAUBRÉE (A.)—Études synthétiques de géologie expérimentale. *Paris*, 1879.

NEWTON (H. A.)—Relation of meteorites and comets. Nature, 1879, p. 315.

BALL (R. S.)—Speculations on the source of meteorites. Nature, 1879, p. 493.

CATALOGUE OF THE COLLECTION OF METEORITES.

The numbers in the first column refer to corresponding numbers placed with the specimens.

The letters in the second column refer to corresponding letters on the cases, and indicate the particular pane of glass behind which the meteorite will be found.

Weights under one gram are not given. 1,000 grams are equivalent to 2·205 lbs.

I. AEROSIDERITES

(OR SKY-IRONS).

No.	Pane.	Name of fall and locality.	Date of fall or find.	Weight in grams.
1	B	**Agram** (Hraschina), Croatia	Fell May 26, 1751	282·3
2		**Tucuman** (Otumpa, Gran Chaco Gualamba), Argentine Republic, S. America	Found 1783	637,000·0
3	B	**Toluca**, Mexico	" 1784	91,007·0
		Ixtlahuacca, Mexico		1,101·0
		Xiquipilco, Mexico		18·2
		Tejupilco, Mexico		,190·0
		Ocatitlan, Mexico		9,431·5
4	B	**Sierra Blanca**, Guyaquilla, Mexico	" 1784	16·0
5	C	**Bahia** (Bemdegó), Brazil	" 1784	2,215·0
6	B	**Zacatecas**, Mexico	" 1792	3,846·9
7	B	**Cape of Good Hope** (between Sunday and Bushman Rivers), Natal, South Africa	" 1793	328·7
8	B	**Elbogen**, Bohemia	.. 1811	94·8
9	C	**Durango**, Mexico	" 1811	440·0
10	C	**Bitburg**, Eifel, Rhenish Prussia	" 1814	1,297·0
11	C	**Red River**, Texas, U.S.A.	" 1814	424·5
12	C	**Scriba**, Oswego County, New York, U.S.A.	" 1814	132·3
13	C	**Lenartó**, Saros, Hungary	" 1815	2,028·5
14	C	**Lockport** (Cambria), New York, U.S.A.	" 1818	5,329·0
15	C	**Davis Strait**, Greenland	" 1819	—
16	C	**Burlington**, Ostego County, New York, U.S.A.	" 1819	290·0
17	C	**Guildford County**, N. Carolina, U.S.A.	" 1820	15·0
18	C	**Rasgatà**, New Granada, S. America	" 1823	58·5

No.	Pane.	Name of fall and locality.	Date of fall or find.	Weight in grams.
19	C	**Santa Rosa,** near Tunja, Boyaca River, New Granada, S. America .	Found 1823	101·0
20	D	**Nauheim,** Frankfurt, Prussia . .	„ 1826	3·6
21	B	**Newstead,** Roxburghshire, Scotland	„ 1827	8,129·0
22	C	**Caille,** near Grasse, Var, France .	„ 1828	374·0
23	D	**Bohumilitz,** Prachin, Bohemia .	„ 1829	118·5
24	E	**Walker** (or **Morgan ?**) **County,** Alabama, U.S.A.	„ 1832	22,295·0
25	D	**Claiborne,** Clarke County, Alabama	„ 1834	24·3
26	D	**Oaxaca** (Mistecà), Mexico . .	„ 1834	316·8
27	D	**Charlotte,** Dickson County, Tennessee, U.S.A.	Fell July 30, 1835	77·5
28	D	**Black Mountain,** Buncombe County, N. Carolina, U.S.A. . .	Found 1835	71·5
29	D	**Great Fish River,** Great Namaqualand, S. Africa . . .	„ 1836?	20·4
30		Desert of **Bolson de Mapimi,** near Santa Rosa, Coahuila, Mexico .	Found 1868 / ? Fell Autumn 1837	250,250·0
31	D	**Ashville,** Buncombe County, N. Carolina, U.S.A.	Found 1839	114·9
32	D	**Putnam County,** Georgia, U.S.A.	„ 1839	112·5
33	I	**Cocke County,** Tennessee, U.S.A.	„ 1840	27,300·0
		Sevier County, do. .	„ 1840	25,025·0
34	L	**Tarapaca** (Hemalga), Arequipa, Peru	„ 1840	1,655·8
35	E	**Smithland,** Livingston County, Kentucky, U.S.A. . . .	„ 1840	2,556·2
36	E	**Babb's Mill,** Green County, Tennessee, U.S.A.	„ 1842	2,164·3
37	D	**Madagascar** (St. Augustine's Bay) .	„ 1843	5·6
38	D	**Arva** (Szlanicza), Hungary . .	„ 1844	9,010·7
39	E	**Caryfort,** De Calb County, Tennessee, U.S.A.	„ 1845	4·5
40	E	**Jackson County,** Tennessee, U.S.A.	„ 1846	91·0
41	D	**Tula** (Netschaëvo), Russia . .	„ 1846	1,076·8
42	G	**Carthage,** Smith County, Tennessee, U.S A.	„ 1846	24,570·0
43	E	**Braunau** (Hauptmannsdorf), Bohemia	Fell July 14, 1847	553·2
44	D	**Seelaesgen,** Brandenburg, Prussia .	Found 1847	9,846·5
45	G	**Murfreesboro',** Rutherford County, Tennessee, U.S.A. . . .	„ 1847	2,794·2
46	E	**Chesterville,** S. Carolina, U.S.A. .	„ 1847	2,250·4
47	F	**Schwetz,** Prussia	„ 1850	1,062·5
48	E	**Salt River,** Kentucky, U.S.A. .	„ 1850	524·0
49	E	**Seneca River,** Cayuga County, New York, U.S.A.	„ 1850	54·5
50	E	**Ruff's Mountain,** Lexington County, S. Carolina, U.S.A. . . .	„ 1850	498·7

No.	Pane.	Name of fall and locality.	Date of fall or find.	Weight in grams.
51	H	**Niakornak,** W. Greenland . .	Found 1850	2,023·0
52	E	**Santa Rosa,** Saltillo, Coahuila, Mexico	„ 1850	26·6
53	F	**Pittsburg,** Pennsylvania, U.S.A. .	„ 1853	208·5
54	G	**Lion River,** Namaqualand, S. Africa	„ 1853	390·0
55	E	**Union County,** Georgia, U.S.A. .	„ 1853	55·0
56	F	**Tazewell,** Claiborne County, Tennessee, U.S.A.	„ 1853	336·5
57	E	**Campbell County,** Tennessee, U.S.A.	„ 1853	10·2
58	E	**Haywood County,** N. Carolina, U.S.A.	„ 1854	—
59	G	**Verknoi-Udinsk,** Transbaikal, Asiatic Russia	„ July, 1854	2,904·0
60	F	**Tabarz,** near Gotha, Saxony . .	Fell Oct. 18, 1854	9·0
61	F	**Sarepta,** Saratow, Russia . .	Found 1854	296·0
62	G	**Madoc,** Upper Canada . . .	„ 1854	216·0
63	G	**Tuczon,** Sonora, Mexico . .	„ 1854	17·4
		Tuczon, Arizona (the "Carleton" meteorite).	„ 1854	308·0
64	G	**Oktibbeha County,** Mississippi, U.S.A.	„ 1854	—
65	G	**Denton County,** Texas, U.S.A.. .	„ 1856	122·0
66	J	**Nelson County,** Kentucky, U.S.A.	„ 1856	3,907·6
67	H	**Orange River,** S. Africa . .	„ 1856	98·0
68	H	**Jewell Hill,** Madison County, N. Carolina, U.S.A.	„ 1856	130·2
69	H	**Marshall County,** Kentucky, U.S.A.	„ 1856	80·3
70	I	**Brazos,** Texas, U.S.A. . . .	„ 1856	20·4
71	H	**Nebraska** (25 miles N.W. of Fort St. Pierre), U.S.A. . . .	„ 1856	134·0
72	I	**Atacama,** Bolivia, S. America .	„ 1858	1,316·0
73	I	**Wayne County** (near Wooster), Ohio, U.S.A.	„ 1859	5·2
74	H	**Lagrange,** Oldham County, Kentucky, U.S.A.	„ Oct. 1860	217·0
75	I	**Coopertown,** Robertson County, Tennessee, U.S.A. . . .	„ 1860	180·0
76	I	**Upernavik,** N.W. Greenland . .	„ 1861	1·4
77		**Cranbourne,** near Melbourne, Victoria, Australia	„ 1861	3,731,000·0
78	I	**Heidelberg,** Baden . . .	„ 1861	2·0
79	I	**Victoria West,** Cape Colony, South Africa	Fell 1862	158·5
80	I	**Howard County** (7 miles S.E. of Kokomo), Indiana, U.S.A. . .	Found 1862	38·0
81	K	**Alabama,** U.S.A.	„ 1863?	40·9
82	I	**Russel Gulch,** Gilpin County, Colorado, U.S.A.	„ Feb. 18, 1863	245·4
83	I	**Dacotah Territory,** U.S.A. . .	„ 1863	223·8

No.	Pane.	Name of fall and locality.	Date of fall or find.	Weight in grams.
84		**Obernkirchen**, near Bückeburg, Schaumburg Lippe, Germany .	Found 1864	35,366·5
85	J	**South-East Missouri**, U.S.A. .	„ —	102·5
86	J	**Charcas**, San Luis Potosi, Mexico.	„ 1865	38·7
87	I	**Bonanza**, Coahuila, Mexico . .	„ 1866	5·0
88	I	**Coahuila**, Mexico (Dr. Butcher's iron)	„ 1866	778·0
89	J	**Bear Creek**, Colorado, U.S.A. .	„ 1866	6·7
90	M	**Barrancas Blancas**, San Francisco Pass, Cordilleras of Atacama, Chili	„ 1866	11,375·0
91	J	**Frankfort** (8 miles S.W. of), Franklin County, Kentucky . . .	„ 1866	98·0
92	J	**Sierra de Deesa**, Chili . . .	„ 1866	12·5
93	J	**Denver**, Colorado, U.S.A. . .	„ 1866	45·6
94	J	**Parambanan**, Socrakarta, India .	„ 1866	8·9
95	J	Near the **River Juncal**, Atacama, Chili	„ 1867	2·6
96	J	**Santa Rosa** (35 miles from), Mexico	„ 1867	8·5
97	J	**Auburn**, Macon County, Alabama, U.S.A.	„ 1867	37·5
98	J	**Losttown** (2½ miles S.W. of), Cherokee County, Georgia, U.S.A. .	„ 1867	6·4
99	A	**San Francisco del Mezquital**, near Durango, Mexico . .	„ 1867	7,528·6
100	I	**Trenton**, Washington County, Wisconsin, U.S.A.	„ 1869	223·0
101	J	Near **Staunton**, Augusta County, Virginia, U.S.A.	„ 1869	1,384·3
102	I	**Shingle Springs**, Eldorado County, California, U.S.A.	„ 1869 or '70	84·5
103	L	**Ovifak**, Disko Island, Greenland (probably terrestrial) . . .	„ 1870	90,300·0
104	L	**Jakobshavn**, Disko Island, Greenland	„ 1870	246·4
105	K	**Smith Mountain**, Rockingham County, Virginia, U.S.A. . .	„ 1870	77·3
106	J	**Nedagolla**, Mirangi, Vizagapatam, India	Fell Jan. 23, 1870	4,379·7
106*	I	**Great Namaqualand** (N. of the Orange River), South Africa .	Before 1873	1,440·0
107	J	**Chulafinnee**, Cleberne County, Alabama, U.S.A. . . .	Found 1873	60·0
108	J	Near **Butler**, Bates County, Missouri, U.S.A.	„ 1874	315·0
109	J	**Morro do Ricio**, Rio Francisco do Sul, Santa Catarina, Brazil . .	„ 1875	6,399·0
110	J	**Rowton**, near Wellington, Shropshire	Fell Apr. 20, 1876	3,109·0

No.	Pane.	Name of fall and locality.	Date of fall or find.	Weight in grams.
111	K	**Ekaterinoslav** (Werchne Dnjeprowsk), Russia		24·8
112	J	**Casey County,** Kentucky, U.S.A.	Found 1877	45·5
113	K	**Whitfield County** (Dalton), Georgia, U.S.A.	„ 1877	146·4
114	M or A	**Mantos Blancos** (Cerro Hicks), N.E. of Antofogasta, Chili, S. America	„ 1877	11,928·0
115	J	**Serrania de Varas,** Atacama, Chili	„ 1877	1,467·0
116	L	**Pfaffoberg** (Dr. Rink's iron) . .		44·0
117	J	**Lexington County,** S. Carolina, U.S.A.	„ 1880	70·0
118	I	**Locality unknown** (from Prof. Wöhler's Collection) . . .	Unknown	—
119	J	**Locality unknown** (Smithsonian Museum iron)	„	5·5

II. AEROSIDEROLITES

(OR SKY-IRON-STONES).

120	K	**Steinbach,** Saxony . . .	Found 1751	130·3
121	K	**Senegal,** Bambuk, Africa . .	„ 1763	10·3
122	K	**Krasnojarsk,** Siberia (the Pallas Iron)	„ 1772	3,235·8
123	K	**Brahin,** Minsk, Russia. . .	„ 1822	22·2
124	K	**Imilac,** Desert of Atacama, Chili, S. America.	„ 1827	227,328·0
125	K	**Hainholz,** Minden, Westphalia .	„ 1856	484·1
126	K	**Newton County,** Arkansas, U.S.A.	„ 1860	29·5
127	K	**Rittersgrün,** Saxony . . .	„ 1861	694·2
128	K	**Johanngeorgenstadt,** Saxony (from the Blumenbach Collection)	„ 1861 ?	1·7
129	K	**Breitenbach,** Bohemia. . . .	„ 1861	6,231·0
130	K	Ravine of **Vaca Muerta,** 36 miles from Guanillo Bay, Desert of Atacama, Bolivia, S. America Sierra de Chaco) . . .	„ 1862	498·5
131	K	**Copiapo,** Chili, S. America . .	„ 1863	2·4
132	K	**Chili** (Copiapo ?), S. America .		818·0
133	K	**Mejillones** (near), Desert of Atacama, Chili, S. America. . .	„ 1867?	2,802·0
134	K	**Chili,** S. America	„ 1870?	608·0
135	M or A	**Estherville,** Emmet County, Iowa, U.S.A.	Fell May 10, 1879	116,487·0
136	K	**Veramin** Teheran, Persia . .	„ April, 1880	53·85

III. AEROLITES
(OR SKY-STONES).

No.	Pane.	Name of fall and locality.	Date of fall.	Weight in grams.
137	V	**Ensisheim**, Elsass, Germany . .	Nov. 7, 1492	458·0
138	Q	**Schellin**, near Stargard, Pomerania, Prussia	April 11, 1715	—
139	P	**Plescowitz**, near Reichstadt, Bohemia	June 22, 1723	25·6
140	Q	**Tabor** (Plan, Strkow), Bohemia .	July 3, 1753	151·0
141	V	**Luponnas**, Ain, France . .	Sept. 7, 1753	1·2
142	O	**Albareto**, Modena, Italy . .	July 1766	2·0
143	O	**Lucé** (Maine), Sarthe, France .	Sept. 13, 1768	11·9
144	P	**Mauerkirchen**, Upper Austria .	Nov. 20, 1768	302·0
145	Q	**Eichstädt**, Bavaria . . .	Feb. 19, 1785	13·8
146	P	**Charkow** (Bobrik), Russia . .	Oct. 13, 1787	437·2
147	W	{ **Barbotan**, } Landes, France . { **Roquefort**, } do. do. .	July 24, 1790	{ 198·5 { 145·5
148	R	**Siena**, Cosona, Italy . . .	June 16, 1794	128·7
149	Z	**Wold Cottage**, Thwing, Yorkshire	Dec. 13, 1795	20,111·0
150	O	**Bjelaja Zerkow**, Kiev, Russia .	Jan. 4, 1797	9·23
151	Q	**Salles**, near Villefranche, Rhône, France	March 8, 1798	165·0
152	S	**Krakhut**, Benares, India . .	Dec. 19, 1798	510·6
153	T	**L'Aigle**, Orne, France . . .	April 26, 1803	2,137·0
154	V	**Apt** (Saurette), Vaucluse, France .	Oct. 8, 1803	37·4
155	W	**Mässing** (St. Nicholas), Bavaria .	Dec. 13, 1803	—
156	V	**High Possil**, near Glasgow, Scotland	April 5, 1804	91·3
157	R	**Darmstadt**, Hesse . . .	Before 1804	1·6
158	Q	Hacienda di **Bocas**, San Luis Potosi, Mexico	Nov. 24, 1804	—
159	Y	**Doroninsk**, Irkutsk, Siberia . .	March 25, 1805	—
160	V	**Asco**, Corsica	Nov. 1805	—
161	Y	**Alais**, Gard, France . . .	March 15, 1806	13·0
162	O	**Timochin**, Juchnow, Smolensk, Russia	March 13, 1807	44·5
163	V	**Weston**, Connecticut, U.S.A. .	Dec. 14, 1807	1,034·5
164	V	**Cusignano** Parish, Noceto, Parma, Italy	April 19, 1808	9·7
165	X	{ **Stannern**, } Iglau, Moravia { **Langenpiernitz**, }	May 22, 1808	{ 1,320·0 { 13·8
166	P	**Lissa**, Bunzlau, Bohemia . .	Sept. 3, 1808	22·6
167	P	**Moradabad**, Bengal, India . .	1808	17·1
168	T	**Mooresfort**, Tipperary, Ireland .	August 1810	345·4
169	P	**Charsonville**, near Orléans, France	Nov. 23, 1810	108·6
170	P	**Kuleschowka**, Poltowa, Russia .	March 12, 1811	57·9
171	Q	**Berlanguillas**, near Burgos, Spain	July 8, 1811	26·5
172	R	**Toulouse** (Grenade), Haute Garonne, France . . .	April 10, 1812	13·7
173	X	**Erxleben**, Prussia . . .	April 15, 1812	31·5

No.	Pane.	Name of fall and locality.	Date of fall.	Weight in grams.
174	W	**Chantonnay,** Vendée, France	Aug. 5, 1812	1,352·3
175	Q	**Limerick** (Adare, Faha, &c.), Ireland	Sept. 10, 1813	114·5
176	W	**Luotolax,** Wiborg, Finland	Dec. 13, 1813	20·7
177	U	Near **Gurram Konda,** between Punganur and Kadapa, Madras, India	1814	9·8
178	S	**Scholakoff,** near Ekaterinoslav, Russia	Jan. 23, 1814	—
179	O	**Wiborg,** Finland	March 1814	94·0
180	O	**Bachmut,** Ekaterinoslav, Russia	Feb. 15, 1814	40·8
181	P	**Agen,** Lot-et-Garonne, France	Sept. 5, 1814	40·6
182	O	**Durala,** Territory of the Patyala Raja, India	Feb. 18, 1815	12,588·9
183	W	**Chassigny,** near Langres, France	Oct. 3, 1815	41·3
184	R	**Zaborzika,** Volhynia, Russia	April 10, 1818	1·3
185	P	**Seres,** Macedonia, Turkey	June 18, 1818	399·6
186	P	**Slobodka,** Juchnow, Smolensk, Russia	Aug. 10, 1818	27·0
187	X	**Jonzac,** Charente inférieure, France	June 13, 1819	9·0
188	Q	**Pohlitz,** near Gera, Reuss, Germany	Oct. 13, 1819	86·9
189	P	**Lixna,** near Dünaburg, Witebsk, Russia	July 12, 1820	59·5
190	X	**Juvinas,** near Libonnez, Ardèche, France	June 15, 1821	940·0
191	P	**Angers,** Maine-et-Loire, France	June 3, 1822	8·3
192	Q	**Agra** (Kadonah), India	Aug. 7, 1822	38·8
193	O	**Epinal** (la Baffe), Vosges, France	Sept. 13, 1822	1·6
194	W	**Futtehpur,** N.E. of Allahabad, India	Nov. 30, 1822	1,286·0
		Bithoor and **Shahpur,** N.W. of Allahabad, India		136·0
195	U	**Umballa,** India	1822–3	20·6
196	X	**Nobleborough,** Maine, U.S.A.	Aug. 7, 1823	—
197	Y	**Renazzo,** Cento, Ferrara, Italy	Jan. 15, 1824	6·2
198	R	**Zebrak,** near Horowitz, Beraun, Bohemia	Oct. 14, 1824	7·9
199	R	Near **Ekaterinoslav,** Russia	1825	—
200	P	**Nanjemoy,** Maryland, U.S.A.	Feb. 10, 1825	325·5
201	Q	**Honolulu,** Owhyhee, Sandwich Islands	Sept. 14, 1825	81·0
202	S	**Paulograd,** Gov. Ekaterinoslov, Russia	May 19, 1826	160·8
203	P	**Mhow,** Ghazeepore, India	Feb. 16, 1827	163·5
204	R	**Drake Creek,** Nashville, Tennessee, U.S.A.	May 9, 1827	19·4
205	W	**Bialystock** (Knasta), Poland	Oct. 5, 1827	3·7

No.	Pane.	Name of fall and locality.	Date of fall.	Weight in grams.
206	X	**Richmond,** Chesterfield County, Virginia, U.S.A.	June 4, 1828	169·5
207	Q	**Forsyth,** Georgia, U.S.A. . .	May 8, 1829	72·5
208	S	**Deal,** near Long Branch, New Jersey, U.S.A.	Aug. 15, 1829	—
209	O	**Krasnoi-Ugol,** Rjäsan, Russia .	Sept. 9, 1829	—
210	R	**Perth,** Scotland	May 17, 1830	1·5
211	W	**Vouillé,** near Poitiers, Vienne, France	July 18, 1831	60·9
212	U	**Wessely,** Hradisch, Moravia. .	Sept. 9, 1831	—
213	O	**Blansko,** Brünn, Moravia . .	Nov. 25, 1833	—
214	Q	**Okniny,** Kremenetz, Volhynia, Russia	Jan. 9, 1834	7·0
215	O	**Charwallas,** near Hissar, India .	June 12, 1834	37·8
216	P	**Mascombes,** Corrèze, France .	Jan. 31, 1835	—
217	P	**Aldsworth,** near Cirencester, Gloucestershire	Aug. 4, 1835	525·4
218	R	**Macayo,** Rio Grande do Norte, Brazil	Nov. 11, 1836	6·4
219	T	**Gross-Diwina,** near Budetin, Trentschin, Hungary . . .	July 24, 1837	—
220	O	**Esnandes,** Charente inférieure. France	Aug. 1837	1·4
221	Q	**Poltawa,** Russia	1838	—
222	R	**Kaee,** Sandee District, Kingdom of Oude.	Jan. 29, 1838	209·2
223	R	**Akburpur,** Saharanpur, India .	April 18, 1838	1,568·7
224	Q	**Chandakapur,** Berar, India. .	June 6, 1838	760·7
225	Y	**Cold Bokkeveldt,** Cape of Good Hope	Oct. 13, 1838	1,057·0
226	Q	**Little Piney,** Pulaski County, Missouri, U.S.A.	Feb. 13, 1839	103·9
227	R	**Uden,** North Brabant, Netherlands	June 12, 1840	5·5
228	W	**Cereseto,** near Ottiglio, Alexandria, Italy	July 17, 1840	124·2
229	X	**Grüneberg,** Heinrichsau, Prussian Silesia	March 22, 1841	30·8
230	X	**Château-Renard,** Triguères, Loiret, France	June 12, 1841	3,290·0
231	P	**Milena,** Warasdin, Croatia . .	April 26, 1842	25·4
232	S	**Aumières,** Lozère, France . .	June 4, 1842	—
233	Y	**Bishopville,** S. Carolina, U.S.A. .	March 25, 1843	512·0
234	R	**Utrecht** (Blaauw-Kapel), Netherlands	June 2, 1843	9·8
235	W	**Manegaum,** near Eidulabad, border of Khandeish, India . . .	June 29, 1843	11·4
236	X	**Klein-Wenden,** near Nordhausen, Erfurt, Prussia	Sept. 16, 1843	5·5

No.	Pane.	Name of fall and locality.	Date of fall.	Weight in grams.
237	O	**Cerro Cosina,** near Dolores Hidalgo, San Miguel, Guanaxuato, Mexico	Jan. 1844 Found 1865	42·1
238	R	**Killeter,** County Tyrone, Ireland .	April 29, 1844	2·7
239	P	**Favars,** Canton Laissac, France .	Oct. 21, 1844	—
240	T	**Louans,** Indre-et-Loire, France .	Jan. 25, 1845	87·0
241	O	**Assam,** India	Found 1846	538·7
242	Q	**Monte Milone** (now called Pollenza), Macerata, Italy . .	May 8, 1846	8·1
243	W	**Linn County** (Hartford), Iowa, U.S.A.	Feb. 25, 1847	942·5
244	S	**Castine,** Maine, U.S.A. . .	May 20, 1848	2·7
245	Y	**Marmande,** Aveyron, France .	July 4, 1848	4·9
246	V	**Schie,** Amt Akershuus, Norway .	Dec. 27, 1848	5·6
247	P	**Cabarras County,** N. Carolina, U.S.A.	Oct. 31, 1849	385·5
248	X	**Shalka,** Bancoorah, Bengal . .	Nov. 30, 1850	1,404·0
249	O	**Gütersloh,** Westphalia, Prussia .	April 17, 1851	109·2
250	Q	**Nulles,** Catalonia, Spain . .	Nov. 5, 1851	4·5
251	Q	**Mainz,** Hesse	Found 1852	33·6
252	R	**Nellore** (Yatoor), Madras, India .	Jan. 23, 1852	11,287·0
253	T	**Mezö-Madaras,** Transylvania .	Sept. 4, 1852	733·7
254	R	**Borkut,** Marmoros, Hungary .	Oct. 13, 1852	40·0
255	Y	**Bustee,** between Goruckpur and Fyzabad, India	Dec. 2, 1852	1,000·0
256	Q	**Girgenti,** Sicily, Italy . . .	Feb. 10, 1853	82·1
257	Q	**Seegowlee,** Bengal, India . .	March 6, 1853	1,205·7
258	V	**Duruma,** Wanikaland, E. Africa .	? March 6, 1853	1·2
259	Q	**Gnarrenburg** (Bremervörde), Hanover	May 13, 1855	808·0
260	T	Island of **Oesel** (Gesinde Kaande, near Piddul), Baltic Sea . .	May 13, 1855	17·9
261	Z	**Igast,** Livland, Russia	May 17, 1855	—
262	P	**St. Denis-Westrem,** near Ghent, Belgium	June 7, 1855	1·3
263	W	Near **Petersburg,** Lincoln County, Tennessee, U.S.A.	Aug. 5, 1855	52·8
264	U	**Trenzano,** Brescia, Italy . .	Nov. 12, 1856	9·8
265	N,Z	**Parnallee,** Madras, India . .	Feb. 28, 1857	61,361·0
266	X	**Stavropol,** north side of the Caucasus, Russia	March 24, 1857	22·6
267	P	**Heredia,** San José, Costa Rica .	April 1, 1857	9·5
268	Y	**Kaba,** Debreczin, Hungary . .	April 15, 1857	104·2
269	Q	Commune **des Ormes,** Yonne, France	Oct. 1, 1857	12·2
270	Q	**Ohaba,** near Karlsburg, Transylvania	Oct. 10, 1857	39·6
271	U	**Pegu** (Quenggouk), India . .	Dec. 27, 1857	654·0
272	P	**Kakova,** Temeser Banat, Hungary	May 19, 1858	160·6

No.	Pane.	Name of fall and locality.	Date of fall.	Weight in grams.
273	W	**Aussun**, Haute Garonne, France .	Dec. 9, 1858	367·2
		Clarac, „ „ „ .		110·3
274	R	**Murcia**, Spain	Dec. 24, 1858	6·1
275	Q	**Bueste**, near Pau, Lower Pyrenees, France	May 1859	3·3
276	Q	**Panpanga**, Philippine Islands .	1859	1·8
277	X	**Harrison County**, Indiana, U.S.A.	March 28, 1859	38·7
278	Q	**Bethlehem**, near Albany, New York, U.S.A.	Aug. 11, 1859	—
279	W	Desert of **Atacama**, Bolivia, S. America	Found 1860?	109·8
280	P	**Alessandria** (San Giuliano Vecchio), Piedmont, Italy	Feb. 2, 1860	35·0
281	U	**Khiragurh**, S.E. of Bhurtpur, India	March 28, 1860	353·3
282	N	**New Concord**, Muskingum County, Ohio, U.S.A.	May 1, 1860	19,519·0
283	V	**Kusiali**, Kumaon, India . .	June 16, 1860	4·1
284	W	**Dhurmsala**, N.E. of Punjaub, India	July 14, 1860	12,407·0
285	Q	**Butsura** (Qutahar Bazaar) India	May 12, 1861	13,071·5
	Q	**Butsura** (Chireya) India		843·0
	P	**Butsura** (Piprassi) India		5,060·0
	P	**Butsura** (Bulloah) India		158·5
286	R	**Canellas**, near Barcelona, Spain .	May 14, 1861	1·5
287	Y	**Grosnja**, Banks of the Terek, Caucasus, Russia	June 16, 1861	15·0
288	R	**Klein-Menow**, Alt-Strelitz, Mecklenburg	Oct. 7, 1862	1,132·0
289	P	**Pulsora**, N.E. of Rutlam, Indore, Central India	Mar. 16, 1863	48·0
290	X	**Buschhof**, Kurland, Russia . .	June 2, 1863	98·1
291	X	**Pillistfer**, Livland, Russia . .	Aug. 8, 1863	13·6
292	O	**Shytal**, 40 miles north of Dacca, India	Aug. 11, 1863	462·7
293	P	**Tourinnes-la-Grosse**, Tirlemont, Belgium	Dec. 7, 1863	60·1
294	X	**Manbhoom**, Bengal, India . .	Dec. 22, 1863	122·9
295	R	**Nerft**, Kurland, Russia . . .	April 12, 1864	69·5
296	Y	**Orgueil**, near Montauban, Tarn-et-Garonne, France . . .	May 14, 1864	621·4
297	R	**Dolgaja Wolja**, Volhynia, Russia .	June 26, 1864	1·5
298	W	**Mouza Khoorna**, Sidowra, Goruckpur District, India . .	Jan. 19, 1865	4,050·6
		Bubuowly Indigo Factory, Supuhee, Goruckpur, India .		200·0
299	V	**Claywater**, Vernon County, Wisconsin, U.S.A.	Mar. 26, 1865	52·1
300	X	**Gopalpur**, Jessore, India . .	May 23, 1865	147·0
301	T	**Dundrum**, Tipperary, Ireland .	Aug. 12, 1865	—

No.	Pane.	Name of fall and locality.	Date of fall.	Weight in grams.
302	S	**Aumale,** near Senahdja, Constantine, Algeria	Aug. 25, 1865	9·1
303	Y	**Sherghotty,** near Gya, Berar, India	Aug. 25, 1865	126·8
304	Q	**Muddoor,** Mysore, India . .	Sept. 21, 1865	407·3
305	Y	**Udipi,** South Canara, India . .	April 1866	3,306·0
306	P	**Pokhra,** near Bustee, Goruckpur, India	May 27, 1866	45·9
307	O	**St. Mesmin,** Aube, France . .	May 30, 1866	41·8
308	O	**Knyahinya,** near Nagy-Berezna, Hungary	June 9, 1866	10,053·0
309	V	**Jamkheir,** Ahmednuggur, Bombay	Oct. 5, 1866	18·8
310	T	**Tadjera,** near Guidjel, Setif, Algiers	June 9, 1867	3·6
311	P	**Khetrie** (Sankhoo, Phulee, &c.), Rajpootana, India . . .	Jan. 19, 1867	13·1
312	Y	**Goalpara,** Assam, India . .	Found.	1,187·0
313	V	**Pultusk** (Sielce, Gostkowo, &c.), Poland	Jan. 30, 1868	14,587·0
314	X	**Daniel's Kuil,** Griqualand, South Africa	March 20, 1868	449·5
315	U	**Slavetic,** Croatia	May 22, 1868	20·7
316	X	**Ornans,** Doubs, France . .	July 11, 1868	1,018·5
317	P	**Sauguis,** St. Etienne, Loire, France	Sept. 8, 1868	4·8
318	W	**Lodran,** Mooltan, India . .	Oct. 1, 1868	66·5
319	R	**Danville,** Alabama, U.S.A. . .	Nov. 27, 1868	27·2
320	W	**Frankfort** (4 miles S. of), Franklin County, Alabama, U.S.A. . .	Dec. 5, 1868	32·0
321	X	**Moteeka Nugla** hamlet, Ghoordha, Bhurtpur, India	Dec. 22, 1868	407·9
322	U	**Hessle,** near Upsala, Sweden .	Jan. 1, 1869	910·4
323	S	**Krähenberg,** Zweibrücken, Rhenish Bavaria	May 5, 1869	2·8
324	S	**Cléguérec,** near Kernouve, Morbihan, France	May 22, 1869	9,346·8
325	X	**Tjabé,** Padangan, Java . . .	Sept. 19, 1869	13·8
326	U	**Stewart County,** Georgia, U.S.A.	Oct. 6, 1869	17·4
327	W	**Ibbenbühren,** Westphalia . .	June 17, 1870	3·0
328	S	**Cabeza de Mayo,** Murcia, Spain .	Aug. 18, 1870	3·4
329	O	**Oczeretna,** Lipowitz, Kiev, Russia	Found 1871	117·2
330	W	**Roda** (4 miles from), Huesca, Spain	Fell 1871	7·7
331	T	**Bandong,** Java	Dec. 10, 1871	14·0
332	X	**Searsmont,** Waldo County, Maine, U.S.A.	May 21, 1871	51·5
333	Y	**Dyalpur,** Sultanpur, Oude, India .	May 8, 1872	269·8
334	O	**Tennassilm,** Turgel, Esthonia, Russia	June 28, 1872	15·8
335	T	{ **Lancé,** Loir-et-Cher, France . Farm of **Veronnière,** St. Amand de Vendôme, Loir-et-Cher, France }	July 23, 1872	{ 34·6 298·3
336	V	**Orvinio,** near Rome, Italy . .	Aug. 31, 1872	62·8

No.	Pane.	Name of fall and locality.	Date of fall.	Weight in Grams.
337	O	**Jhung,** Punjaub, India . . .	June 1873	1,984·0
338	X	**Khairpur,** 35 miles east of Bhawalpur, India	Sept. 23, 1873	2,991·0
339	W	**Waconda,** Mitchell County, Kansas, U.S.A.	Found 1874	467·5
340	Y	**Sewrukowo,** near Belgorod, Kursk, Russia	May 11, 1874	20·1
341	O	**Nash County** (near Castalia), N. Carolina, U.S.A..	May 14, 1874	29·4
342	S	**Kerilis,** Mael Pestivien, Côtes-du-Nord, France	Nov. 26, 1874	5·9
343	Q	Near **West Liberty,** Iowa County, Iowa, U.S.A.	Feb. 12, 1875	3,780·0
344	V	**Sitathali,** Raepur, Rajpootanah, India	March 4, 1875	600·0
345	R	**Zsadany,** Temeser Banat, Southern Hungary	March 31, 1875	25·2
346	Y	**Nageria,** Fathabad, Agra, India .	April 24, 1875	8·5
347	T	**Ställdalen,** Nya Kopparberg, Sweden	Jan. 28, 1876	1,563·0
348	R	**Judesegeri,** Kadaba Taluk, Mysore, India	Feb. 16, 1876	135·1
349	T	**Vavilovka,** Cherson, Russia . .	June 19, 1876	1·8
350	X	**Rochester,** Fulton County, Indiana, U.S.A.	Dec. 21, 1876	8·5
351	S	**Cronstadt,** Orange River Free State, S. Africa	1877	346·6
352	X	**Warrenton,** Warren County, Missouri, U.S.A.	Jan. 3, 1877	82·5
353	W	**Cynthiana** (9 miles from), Harrison County, Kentucky, U.S.A. .	Jan. 23, 1877	154·8
354	R	**Hungen,** Hesse, Germany . .	May 17, 1877	5·4
355	X	**Soko-Banya,** N.E. of Alexinatz, Servia	Oct. 13, 1877	1,975·0
356	X	**Tieschitz,** Prerau, Moravia . .	July 15, 1878	17·3
357	P	**Dandapur,** Goruckpur, India .	Sept. 5, 1878	2,245·0
358	W	**Rakofka,** Tula, Russia . .	Nov. 20, 1878	375·0
359	R	**Middlesborough,** Yorkshire .	March 14, 1881	16·3
360	S	**Gross Liebenthal,** 12 miles S.S.W. of Odessa, Russia . . .	Nov. 19, 1881	8·5
361	R	**Mocs,** Kolos, Transylvania . .	Feb. 3, 1882	13,100·0
		Báré, ,, ,, . .		1,233·2
		Gyulatelke, ,, ,, . .		81·6
		Visa, ,, ,, . .		17·5

CASTS OF METEORITES.

Owing to the distribution of the original meteorites among various Museums, the specimens referred to in the preceding Catalogue (pages 135–144) are generally of a more or less fragmentary nature. Previous to this division casts have in many instances been taken with the view of preserving the original form. The following is an alphabetical list of the casts in charge of the Department:—

Akburpur
Barrancas Blancas
Bithoor and Shahpur
Braunau
Breitenbach
Bustee
Butsura
Charlotte
Cronstadt
Daniel's Kuil
Dundrum
Durala
Goalpara
Gopalpur
Jhung
Kaee
Khiragurh
Klein-Menow
Launton
Linn County
Mhow
Middlesborough
Mouza Khoorna
Nedagolla
Nellore
Newstead
Obernkirchen
Parnallee
Petersburg
Pulsora
Rowton
Sarepta
Schie
Seegowlee
Shytal
Sitathali
Udipi
West Liberty

They are exhibited in the lower parts of the meteorite cases.

By written application to the Principal Librarian, or to the Formatori (Messrs. D. Brucciani & Co., 40, Russell Street, Covent Garden, London), casts of any of the above meteorites can be obtained on payment of the necessary expenses.

INDEX.

Synonyms are printed in Roman type. The numbers refer to those in the first column of the preceding Catalogue.

Jan. 1*st*, 1883. L. FLETCHER.

DEPARTMENT OF BOTANY.

The Collections of the Botanical Department consist of two portions, the one set apart for the use of persons engaged in the scientific study of plants; the other open to the public and consisting of specimens suitable for exhibition, and intended to illustrate the various groups of the Vegetable Kingdom, and the broad facts on which the Natural System of the classification of plants is based.

The portion devoted to the use of the scientific student consists mainly of the great Herbarium. This is a collection of plants, fastened on single sheets of folio paper, representing, as far as it has been possible to obtain them, first, every species of plant living on the earth, and then the distribution of each species on the surface of the earth. The various species are collected under their respective genera, and these are arranged in their Natural Orders, and the whole are systematically classified, beginning with the most highly organized (the *Ranunculaceæ*), and going down to the lowest members of the Vegetable Kingdom (the *Fungi*).

The foundation of this great Herbarium was the collection of Sir Joseph Banks, consisting of the plants obtained by himself and Dr. Solander in their voyage round the world with Captain Cook, and of numerous series from all quarters of the globe presented to him or purchased by him. He bequeathed all his botanical collections to the Trustees of the British Museum in 1820, reserving to Robert Brown, in whose charge they had been for years, the use of them during his lifetime. Mr. Brown transferred them to the Trustees of the Museum in 1827, and was appointed the first Keeper of the Department. The yearly additions since 1827 have been so extensive that the Banksian collections form now but a small proportion of the great Herbarium. In a brief notice it is impossible to give a correct idea of the richness of this Herbarium. Among the principal collections contained in it may be mentioned those of Clayton, Roemer, Miller, Brown, Bowie and Cunningham, Gardner, Nuttall, Horsfield, König, Martin, Masson, Wilson, Hampe, Seemann, Welwitsch, Salt, and Miers. It includes also authentic specimens received from Loureiro, Gronovius, Tournefort, Jacquin, Aublet, Ruiz and Pavon, and Perrottet.

There is a separate Herbarium of British plants, based on the collections formed by Sowerby in the preparation of his great work, "English Botany." This is, perhaps, the largest and most interesting public Herbarium of British plants, and its value is constantly increasing by additions from botanists who make the British Flora their special study.

The extensive Herbarium formed by Sir Hans Sloane became the property of the nation in 1753, along with his other collections. The plants gathered by himself in Jamaica form the nucleus of this Herbarium, and added to them are the collections of Petiver, Buddle, Plukenet, Kaempfer, Kamel, Merrett, Boerhaave, Vaillant, Banister, and others. According to the practice of the time these plants are preserved in large folio volumes, of which there are altogether 310. This collection had been placed in the Library of the British Museum, and remained there until the establishment of the Department of Botany, when it was transferred to the care of Mr. Brown. The plants are well preserved, and are catalogued in a copy of Ray's "Historia Plantarum," so that they can be easily consulted.

The collections formed by Hermann in Ceylon, from which Linnaeus prepared his "Flora Zeylanica," are preserved in five volumes, four containing plants, and the fifth consisting of drawings.

The Department also contains the singularly interesting and valuable collection of plants gathered in 1663 by John Ray in his travels in Europe, a catalogue of which was published in his account of his Journey in 1673.

In these various Herbaria, the Museum possesses an unsurpassed series of historical collections from the middle of the seventeenth century to the present time.

Besides the collection of dried plants forming the Herbarium, there are two allied collections arranged in the same gallery in parallel series. The one is the collection of fruits and seeds occupying the table cabinets in the centre of the gallery, and the other the collection of woods placed in the smaller cabinets in the centre of each bay. The position of the cabinets has permitted the arrangement of the specimens belonging to these two collections in close proximity to the Natural Orders in the Great Herbarium, to which they belong. The student can thus easily command the specimens in the three collections in the prosecution of his investigations. Nor is the facility of reference confined to the mounted and finally arranged specimens, for the method in which the unmounted collections are arranged and temporarily stored in small rooms behind the great Herbarium, provides for their ready consultation, even before they are incorporated in the Herbarium itself.

The student receives assistance in his investigations from the Library of the Department, already extensive, and rapidly increasing; and from a large collection of plates and drawings of plants systematically arranged in the same order as the plants in the Herbarium.

The collection of original drawings comprises specimens of the work of the principal botanical artists such as Ehret, J. Miller, Nodder, Aubriet, Sidney Parkinson, Sowerby, Fitch, and especially Francis and Ferdinand Bauer.

The Department possesses also many valuable manuscripts, such as those of Robert Brown, Solander, Ruiz and Pavon, König, Salisbury, and Miers, referring to plants now in the Herbarium, on which these botanists have worked.

The arrangement of the collections in the Public Gallery is now in progress, but is not sufficiently advanced to permit the preparation of a guide to the cases at the time when these pages must go to press. A general account of the plan being followed in this arrangement and of the principal specimens is all that can now be attempted.

The Natural System of Classification, according to which the plants in the Herbarium are arranged, is followed in the exhibition cases in the public gallery. A half case next to the door on the left side is devoted to a diagrammatic and tabular exposition of the great groups of the Vegetable Kingdom. The series of specimens begins in the next case with the Natural Order *Ranunculaceæ*, and the principal Orders are represented in this and the following cases by the help of dried specimens of the plants themselves, by fruits, and by prepared sections of the woods. Diagrams are employed to emphasise the characters on which the grouping is based. The use of the same colour for the homologous structures throughout the diagrams readily conveys to the eye the points of agreement and difference on which the classification rests. The geological history of each Natural Order is indicated on a table of the earth's strata; and its present distribution on the surface of the earth is given on a small map of the world. Descriptive labels give particular information respecting each specimen.

Dicotyledonous plants occupy three cases on the left side of the gallery, and are followed by the Monocotyledonous Orders which fill the last case on the same side, the two half cases at the end of the gallery, and the first case returning towards the door. The Gymnosperms are placed in the next case. Then follow the Cryptogams, a case being devoted to the higher vascular Orders, and another to the lower division of cellular plants. The series closes with an interesting collection of models of the larger British *Fungi* prepared by Sowerby when he was engaged on his work on this group of plants.

The larger specimens are placed in the tall cases in the centre of the gallery following the order as far as possible of the specimens in the wall cases. The right side of the first centre case is filled with specimens of Dicotyledonous plants, such as sections of White Oak and Walnut from Canada, of *Eucalyptus*, *Acacia*, *Laportea*, and other trees from Australia, of the Cork Oak grown in Chelsea Gardens, trunks of *Ficus* and *Carallia* with aerial roots, sent from Ceylon by Dr. Trimen, stems of *Bombax* and *Xanthoxylon* with conical prickles, and of *Flacourtia* and *Gleditschia* with branching thorns, and anomalous stems of *Bauhinia*, *Entada*, and *Dypsis*. The next two centre cases are filled with Monocotyledonous plants, among which in the first case are stems and sections of the Date palm, several species of *Areca*, sections and fruit of the Palmyra palm, stem and fruit of the Sago palm, and a large spike of the allied *Raphia* from Madagascar. In the next case are stems of the Wax palm, sections and fruit of the Cocoa-nut palm, and of the Seychelles palm. The remainder of this case is occupied with specimens of the Dragon-tree of Madeira, of the Grass-trees and Black-boys of Australia, of *Vellozia* from Brazil, of *Papyrus* from Egypt, of Bamboo and Sugar-cane. On the other side of this case specimens of Gymnosperms will be found, comprising a large plant of *Welwitschia* from Africa, sections of *Araucaria* from Norfolk Island, of Cedar grown in Chelsea Gardens, and stems and sections of several species of *Cycadeæ*. The next two cases contain specimens of Tree-ferns, among which are a large stem of *Dicksonia*, clothed with aerial roots, from New Zealand, stems of species of *Alsophila* and *Cyathea* from various tropical regions, and of *Hemitelia* from South Africa.

W. CARRUTHERS.

LIST OF THE

BRITISH MUSEUM PUBLICATIONS.

The following Publications can be purchased at the Museum, or of Messrs. LONGMANS & Co., 39, *Paternoster Row*; *Mr.* QUARITCH, 15, *Piccadilly; Messrs.* ASHER & Co., 13, *Bedford Street, Covent Garden; and Messrs.* TRÜBNER & Co., 57, *Ludgate Hill.*

ANTIQUITIES.

Description of the Ancient Terracottas, by T. Combe, 1810, 4to. £1 11*s*. 6*d*.—Large paper, £2 12*s*. 6*d*.

——————— Marbles, Part I., by the same, 1812, 4to. £1 5*s*.—Large paper, £1 15*s*.

——————— Part II., by the same, 1815, 4to. £2 12*s*. 6*d*.—Large paper, £3 13*s*. 6*d*.

——————— Part III., by the same, 1818, 4tc. £1 10*s*.—Large paper, £2 2*s*.

——————— Part IV., by the same, 1820, 4to. £2 2*s*. —Large paper, £3 3*s*.

——————— Part V., by E. Hawkins, 1826, 4to. £1 1*s*. —Large paper, £1 11*s*. 6*d*.

——————— Part VI., by C. R. Cockerell, 1830, 4to. £2 2*s*.—Large paper, £3 3*s*.

——————— Part VII., by E. Hawkins, 1835, 4to. £2 2*s*.—Large paper, £3 3*s*.

——————— Part VIII., by the same, 1839, 4to. £3 3*s*.—Large paper, £4 14*s*. 6*d*.

——————— Part IX., by the same, 1842, 4to. £2 2*s*. —Large paper, £3 3*s*.

——————— Part X., by the same, 1845, 4to. £3 3*s*. —Large paper, £4 14*s*. 6*d*.

——————— Part XI. by S. Birch, 1861, 4to. £3 3*s*. —Large paper, £4 14*s*. 6*d*.

Catalogue of the Greek and Etruscan Vases in the British Museum, Vol. I., 1851, 8vo. 5*s.*—Fine paper, 7*s.* 6*d.*

——— Vol. II., 1870, 8vo. 5*s.*; fine paper, 7*s.* 6*d.*

Inscriptions in the Cuneiform Character, from Assyrian Monuments, discovered by A. H. Layard, D.C.L., 1851, fol. £1 1*s.*

Cuneiform Inscriptions of Western Asia. Prepared for publication by Maj.-Gen. Sir H. C. Rawlinson, K.C.B., assisted by E. Norris, Sec. R. As. Soc., Vol. I., 1861, fol. £1.

——— Vol. II., 1866, fol. £1.

——— Vol. III. Prepared for publication by Major-General Sir H. C. Rawlinson, K.C.B., F.R.S., &c., assisted by George Smith, Department of Antiquities, British Museum. 1870, fol. £1.

——— Vol. V. Plates I.—XXXV. Prepared for publication by Major-General Sir H. C. Rawlinson, K.C.B., F.R.S., &c.; assisted by Theophilus G. Pinches, Department of Antiquities, British Museum. 1880, fol. 10*s.* 6*d.*

Inscriptions in the Phœnician Character, discovered on the side of Carthage, during Researches by Nathan Davis, Esq., 1856–58. 1863, fol. £1 5*s.*

Inscriptions in the Himyaritic Character, discovered chiefly in Southern Arabia, 1863, fol. £1 4*s.* boards.

Inscriptions in the Hieratic and Demotic Character, 1868, fol. £1 7*s.* 6*d.*

Ancient Greek Inscriptions. Part I., Attika, 1874, fol. £1.

COINS.

Nummi Veteres in Museo R. P. Knight ab ipso descripti, 1830, 4to. £1 15*s.*

Catalogue of the Anglo-Gallic Coins, by E. Hawkins, 1826, 4to. £1 4*s.*

——— Greek Coins in the British Museum. Italy, 1873, 8vo. £1 5*s.* Woodcuts.

——— Sicily, 1876, 8vo. £1 1*s.* Woodcuts.

——— Thrace, 1877, 8vo. £1 1*s.* Woodcuts.

——— Seleucid Kings of Syria, 1878, 8vo. 10*s.* 6*d.* Autotype Plates.

——— Macedonia, 1879, 8vo. £1 5*s.* Woodcuts and a Map.

——— Roman Coins in the British Museum.—Roman Medallions, 1874, 8vo. £1 1*s.*

——— Oriental Coins in the British Museum.—Vol. II. The Coins of the Mohammadan Dynasties. 1876, 8vo. 12*s.*

Catalogue of Oriental Coins in the British Museum.—Vol. III. The Coins of the Turkumán Houses. 1877, 8vo. 12*s.*

——— Vol. IV. The Coinage of Egypt. 1879, 8vo. 12*s.*

Catalogue of Oriental Coins in the British Museum.—Vol. V. The Coins of the Moors. 1880, 8vo. 9*s.*

——————————————— Vol. VI. The Coins of the Mongol Dynasty. 1881, 8vo. 15*s.*

——————————————— Vol. VII. The Coins of the House of Timur. 1882, 8vo. 9*s.*

PAPYRI.

Greek Papyri in the British Museum. Part I. 1839, 4to. 10*s.*—Large Paper, 15*s.*

Select Papyri in the Hieratic Character. Part I. Plates XXXV.—XCVIII., 1842, fol. stitched, £1 10*s.* ; boards, £1 12*s.* 6*d.*

——————————————— Plates XCIX.—CLXVIII., 1844, fol. stitched, £1 16*s.* ; boards, £1 18*s.* 6*d.*

——————————————— Part II. Plates I.—XIX. 1860, fol. stitched, £1 ; boards, £1 2*s.* 6*d.*

Fac-simile of an Egyptian Hieratic Papyrus of the reign of Rameses III., now in the British Museum, 1876, fol. £3.

Photographs of the Papyrus of Nebseni in the British Museum, 1876. Unmounted, £2 2s. (Mounted copies and copies in portfolios may be obtained on special terms.)

MANUSCRIPTS.

Catalogue of the MSS. formerly F. Hargrave's, by H. Ellis, 1818. 4to. 12*s.*

——————— Arundel MSS., 1834, fol. £1 8*s.*; or with coloured Plates, £4 14*s.* 6*d.*

——————— Burney MSS., 1840, fol. 18*s.*; or with coloured Plates, £3 3*s.*

Index to the Arundel and the Burney MSS., 1840, fol. 15*s.*

Catalogus Codicum Manuscriptorum Orientalium. Pars 1. Codices Syriacos et Carshunicos amplectens, 1838, fol. 12*s.*

——————————————— Pars 2. Codicum Arabicorum partem amplectens, 1847, fol. 14*s.*

——————————————— Partis 2 continuatio, 1852, fol. 14*s.*

——— Partis 2 supplementum, 1871, fol. £2.

——— Pars 3. Codices Æthiopicos amplectens, 1847, fol. 10*s.*

Catalogue of Syriac Manuscripts in the British Museum acquired since the year 1838. By W. Wright, LL.D. Part I., 1870, 4to. 15*s.*

——— Part II., 1871, 4to. £1 5*s.*

——— Part III., with Appendices and Indices, 1873, 4to, £1 10*s.*

————— Ethiopic Manuscripts in the British Museum, by W. Wright, LL.D. 1877, 4to. 28*s.*

Catalogue of the Persian Manuscripts in the British Museum. Vol. I. 1879, 4to. £1 5*s.*

Catalogue of the Persian Manuscripts in the British Museum, Vol. II. 1881, 4to. £1 5*s.*

Codex Alexandrinus, in fac-simile type, 3 vols. fol. £18.

Fac-simile of the Codex Alexandrinus (autotype), New Testament and Clementine Epistles. Vol. IV., 1879, fol. £7.

*———————— (Genesis to 2 Chronicles, ff. 276). Vol. I., 1881, fol. £9.

Fac-similes of Ancient Charters in the British Museum. 1873, fol. £1 1*s.*

———————— Part II. 1876, fol. £1 10*s.*

———————— Part III., 1877, fol. £1 10*s.*

———————— Part IV., 1878, fol. £2 2*s.*

List of Additions, MSS. 1836–1840, 8vo. 10*s.*

Catalogue of Additions, MSS. 1841–1845, 8vo. £1.

———————— MSS. 1846–1847, 8vo. 12*s.*

———————— MSS. 1848–1853, 8vo. 15*s.*

———————— MSS. 1854–75. Vol. I. 1854–1860, 8vo. 15*s.*

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Index to the Catalogue of Additions, MSS., 1854–1875, 8vo, £2 2*s.*

Catalogue of MS. Music in the British Museum, 1842, 8vo. 5*s.*

———— MS. Maps, Charts, and Plans, 1844, 2 vols. 8vo. £1.

———— Spanish Manuscripts. Vol. I., 1875, 8vo. 15*s.*

———————— Vol. II., 1877, 8vo. 15*s.*

———————— Vol. III., 1881, 8vo. 15*s.*

Fragments of the Iliad of Homer from a Syriac Palimpsest, edited by William Cureton, M.A., 1851, 4to. £2 2*s.*—Large paper, £3 3*s.*

Photographic Fac-similes of the Epistles of Clement of Rome, £3 3*s.*

Photograph of Shakespeare Deed, 2*s.*

Catalogue of Ancient MSS. in the British Museum. Part I. Greek. 1881, fol. £1.

PRINTED BOOKS.

Catalogue of Printed Books in the British Museum. Vol. I., 1841, folio, 18*s.* sheets; £1 boards.

———— the Hebrew Books in the British Museum, 1867, 8vo. £1 5*s.*

———— the Sanskrit and Pali Books in the British Museum, 1876, 4to. £1 1*s.*

———— Chinese Books, &c., in the British Museum. 1877, 4to. 20*s.*

Bibliotheca Grenvilliana, Part II., 1848, 8vo. £1 11*s.* 6*d.*

———————— Part III., 1872. Large paper, £2 2*s.* Small paper, 15*s.*

* To be obtained *only* at the British Museum.

List of Books of Reference in the Reading-Room of the British Museum, 1871, 8vo. 5*s*. With Coloured Plan. (The Plan separately, 6*d*.)

List of Bibliographies, Classified Catalogues and Indexes in the Reading Room of the British Museum. 1881, 8vo. cloth covers, 2*s*. 6*d*.; paper covers, 2*s*.

MAPS.

Catalogue of the Geographical Collection in the Library of King Geo. III., 1829, 2 vols. 8vo. £1 4*s*.

PRINTS AND DRAWINGS.

Catalogue of Prints and Drawings in the British Museum. Division I. Political and Personal Satires. Vol. I., 1320 to April 11, 1689. 1870, 8vo. £1 5*s*.

——— Vol. II. June, 1689 to 1733. 1873, 8vo. £1 10*s*.

——— Vol. III. March 28, 1734, to *c*. 1760. 1877, 2 vols. 8vo. £2 2*s*.

Catalogue of Playing and other Cards in the British Museum, by W. H. Willshire, M.D., Edin. 1876–77, 8vo. 21*s*.

Catalogue of Early Prints. Vol. I. German and Flemish Schools, by W. H. Willshire, M.D., Edin. 1879, 8vo. 12*s*. 6*d*.

NATURAL HISTORY.

MAMMALS.

Catalogue of Carnivorous Mammalia, 1869, 8vo. 6*s*. 6*d*. Woodcuts.

——— Ruminant Mammalia (Pecora), 1872, 8vo. 3*s*. 6*d*.

Hand-List of the Edentate, Thick-skinned, and Ruminant Mammals in the British Museum. 1873, 8vo. 12*s*. Plates.

Catalogue of Seals and Whales, 2nd edition, 1866, 8vo. 8*s*. Woodcuts.

——— Supplement, 1871, 8vo. 2*s*. 6*d*. Woodcuts.

Hand-List of Seals, Morses, Sea-Lions, and Sea-Bears. 1874, 8vo. 30 Plates of Skulls, 12*s*. 6*d*.

Catalogue of Monkeys, Lemurs, and Fruit-eating Bats, 1870, 8vo. 4*s*. Woodcuts.

——— Bones of Mammalia, 1862, 8vo. 5*s*.

——— Chiroptera, 1878, 8vo. £1 10*s*. Plates.

BIRDS.

Catalogue of the Birds in the British Museum. Vol. I., 1874. Accipitres, or Diurnal Birds of Prey, 8vo. Woodcuts and 14 coloured Plates, 19*s*.

——— Vol. II., 1875, Striges, or Nocturnal Birds of Prey, 8vo. Woodcuts and 14 coloured Plates, 16*s*.

——— Vol. III., 1877. Coliomorphæ, 8vo. Woodcuts and 14 coloured Plates, 17*s*.

——— Vol. IV., 1879. Passeriformes, 8vo. Woodcuts and 14 coloured Plates, £1.

——— Vol. V., 1881. Passeriformes, 8vo, 18 coloured Plates, £1.

——— Vol. VI., 1881. Passeriformes, 8vo, 18 coloured Plates. £1.

Hand-List of Birds, Part I., 1869, Accipitres, Fissirostres, Tenuirostres, Dentirostres, 8vo. 7*s*.

——— Part II., 1870, Conirostres, Scansores, Columbæ, Gallinæ, 8vo, 6*s*.

——— Part III., 1871, Struthiones, Grallæ, and Anseres, with Indices, 8vo, 8*s*.

List of Birds, Part III., Sects. III. and IV., Capitonidæ and Picidæ, 1868, 12mo. 1*s*. 6*d*.

——— Part V., Gallinæ, 1867, 12mo. 1*s*. 6*d*.

Catalogue of the Birds of the Tropical Islands of the Pacific, 1859, 8vo. 1*s*. 6*d*.

FISHES.

Catalogue of Fishes, Vol. I., 1859, 8vo. 10*s*.

——— Vol. II., 1860, 8vo. 8*s*. 6*d*.

——— Vol. III., 1861, 8vo. 10*s*. 6*d*.

——— Vol. IV., 1862, 8vo. 8*s*. 6*d*.

——— Vol. V., 1864, 8vo. 8*s*.

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