John Playfair | Encyclopedia.com

(*b*. Benvie, near Dundee, Scotland, 10 March 1748; *d*. Edinburgh, Scotland, 20 July 1819)

mathematics, physics, geology.

Playfair was the eldest son of the Reverend James Playfair. At the age of fourteen he went to the University of St. Andrews, primarily to qualify for the ministry, but he also showed remarkable mathematical ability. In 1769 he left St. Andrews for Edinburgh. On the death of his father in 1772, he succeeded him in the living of Benvie. which he resigned in 1782 to become tutor for a private family. From 1785 to 1805 Playfair held a professorship of mathematics at the University of Edinburgh. He edited the *Transactions of the Royal Society of Edinburgh* for many years, and most of his papers appeared in that periodical. They were concerned almost entirely with mathematics, physics, and biographies. His *Elements of Geometry* was published in 1795. Following the death in 1797 of his friend James Hutton, Playfair proceeded to make a careful analysis, clarification, and amplification of Hutton's *Theory of the Earth*, which had originally been presented as a paper read in 1785 to the Royal Society of Edinburgh and was expanded into the two-volume work of 1795. Playfair's efforts resulted in *Illustrations of the Huttonian Theory of the Earth*(1802). In 1805 he became professor of natural philosophy at Edinburgh, where his lectures now embraced physics and astronomy. His *Outlines of Natural Philosophy* was published in 1814.

Playfair's professional work was thus in mathematics and physics. His book on geometry is a full presentation of the first six books of Euclid, with much additional material. The formal treatment of linear parallelism requires axioms. Finding Euclid's axioms on this matter to be unsatisfactory, Playfair proposed "that two straight lines, which intersect one another, cannot be both parallel to the same straight line." This is what became known as "Playfair's axiom," as it is given in his *Elements of Geometry*.

Playfair's fame as a scientist, however, rests almost entirely on his work in geology—hardly a "professional" study at the time—in presenting Hutton's momentous theory in a clear and palatable form (which Hutton himself had failed to do), and in adding materially to the geological knowledge of the time. The precision and elegance of the style of his mathematical exposition is here applied to a descriptive, inductive science. As Archibald Geikie remarked (1905): "How different would geological literature be to-day if men had tried to think and write like Playfair!" The publication of the *Illustrations* is indeed one of the most conspicuous landmarks in the progress of British geology. It ended the early period in the history of that science, a termination that happened to coincide with the end of the eighteenth century. There was a pause in the advance of geology during the early years of the nineteenth century; but powerful forces were gathering an impetus that was released in the second decade with the publication of important works by William Smith, John Farey, and Thomas Webster, which were summarized in the next landmark of the literature, Conybeare and Phillips' *Outlines of the Geology of England and Wales* (1822). Playfair lived well into this second period of activity but did not take any part in it. A project that was very much in his mind was the preparation of a comprehensive work on geology, which was to have been a greatly amplified edition of his *Illustrations*. The peace of 1815 enabled Playfair to make an extensive tour of France, Switzerland, and Italy, in order to extend his observations for this purpose; but although we have details of the journey, nothing of the projected work was composed.

By the end of the eighteenth century the rocks of Britain had been classified into two main groups, the Primary (at first called "Primitive") and the Secondary. This division was based on observed superposition, particular attention being paid to unconformities and, as the names show, on the consequently inferred relative ages. The grouping is in fact a natural twofold occurrence in many regions, but the stratigraphical (time) gap is not everywhere at the same part of the general succession; for instance, over much of Scotland it is below the Old Red Sandstone, in northwest England below the Carboniferous, and in south Wales and southwest England below the Permo-Triassic or the Lias. This discrepancy was not known at the time; and long after the end of the eighteenth century the Devonian and Carboniferous rocks of Devon and Cornwall were thought to be equivalent in age to rocks below the Old Red Sandstone elsewhere. As for the igneous rocks, the large granite masses were generally believed to be among the most ancient; but since their intrusive nature had been demonstrated, this assumption was found to rest on no very secure basis. They had not, however, yet been discovered as being intrusive into any but Primary rocks. The smaller intrusions, dikes and sills, found among Secondary rocks, were necessarily accepted as being comparatively young. In fact, the logical position had been reached of a preliminary classification of rocks, regardless of age, into the two lithological groups: igneous and sedimentary.

It is not surprising that no classification of the Primary rocks had been attempted. Particular rocks were simply described by such lithological or mining terms as schistus. slate, killas, and clay-slate, which had no very precise meaning. Within the Secondary group a very rough succession from the Coal Measures to the Chalk had been given by John Strachey (1725), and

John Michell (1788) had offered a more accurate succession of the same range of strata. In those regions where the Carboniferous succession had been observed —in Scotland (by John Williams, 1789) and, particularly, in Derbyshire (by John Whitehurst, 1778)—the Limestone was found to underlie the Coal Measures, with Millstone Grit (if present) intermediate. It does not seem that the stratigraphic relation of the Old Red Sandstone (the equivalent in age to the marine Devonian) to the Carboniferous rocks had been observed. The question arises of the extent to which a geological map of Britain could have been constructed from the observations recorded up to 1802. The map would have been very sketchy; and no one made any serious attempt at such a compilation, although William George Maton drew a very inaccurate "mineralogical map" of southwest England in 1797. The geological researches of William Smith had begun about 1790. In 1801 he colored geologically a small map of England and Wales, and in 1815 his great map of England and Wales was published.

Such was the position when Playfair wrote his book, which divided two eras in the history of geological investigation. His own observations, inferences, and expressions were the final contributions to the first era and can be classed under three heads.

First, Playfair realized the importance of unconformity in the manifestation of the geological cycle; and he searched throughout Britain for signs of this kind of structural relation, to add to the instances already recorded by Hutton. (Unconformity implies the operation of the "geological cycle"—deposition, deformation, emergence, erosion, submergence, and deposition. The concept of the geological cycle is the essence of Hutton's theory.) Thus Playfair observed the unconformity between the Permo-Triassic and Devonian to be seen at places on the coasts of both north and south Devonshire, and that between the Old Red Sandstone and Dalradian ("Primary schistus") on the east and west coasts of Scotland. He graphically described the unconformity between the Carboniferous Limestone and pre-Devonian rocks in the Ingle-borough district of Yorkshire (the British region that shows this phenomenon most clearly) and gave a glimpse of the structure of the English Lake District with its rim of unconformable Carboniferous rocks.

Second, Playfair made miscellaneous observations, of which the more significant were the fossiliferous nature of the Primary Devonian limestone at Plymouth; the fractures, curiously plane without shattering, in the Old Red Sandstone conglomerate at Oban in Scotland; the general constancy of the east-northeast/west-southwest trend in the structure of the older rocks of Britain; the form of the intrusive sill at Salisbury Craigs and the metamorphism at the volcanic neck of Arthur's Seat, in the neighborhood of Edinburgh; the small-scale folding in the Dalradian schist of Ben Lawers, which he noticed resembled that in the Alpine region; intrusive veins in Ayrshire and Arran and the contact metamorphism produced by them; the flint-gravels of southern England as the residue of dissolved flinty chalk; and the submerged forest of the Lincolnshire coast.

Third, Playfair's book used many more-or-less ordinary words (arenaceous, consolidated, petrifaction) in modern geological senses, most of them probably for the first time, and introduced several highly significant terms into geological literature (geological cycle, igneous origin). His name is attached to a geomorphological "law," "Playfair's law of accordant junctions," which, as given in the *Illustrations*, states that "Every river appears to consist of a main trunk, fed from a variety of branches, each running in a valley proportioned to its size, and all of them together forming a system of vallies, communicating with one another, and having such a nice adjustment of their declivities that none of them join the principal valley on too high or too low a level,—a circumstance which would he infinitely improbable if each of these vallies were not the work of the stream that flows in it."

BIBLIOGRAPHY

I. Original Works. Playfair's chief writings are *Elements of Geometry* (Edinburgh, 1795); *Illustrations of the Huttonian Theory of the Earth* (Edinburgh, 1802); *Outlines of Natural Philosophy* (Edinburgh, 1814); and *A General View of the Progress of Mathematical and Physical Science Since the Revival of Letters in Europe*, vols. II and IV of *Encyclopaedia Britannica*, supp. (1816). In *The Works of John Playfair*, James G. Playfair, ed., 4 vols. (Edinburgh, 1822), "are contained all the publications to which Mr. Playfair affixed his name, with the exception of the *Elements of Geometry*, and of the *Outlines of Natural Philosophy*, which were intended only for the use of students, and although excellently adapted to their object, would possess but little interest for the general reader." Vol. I contains a biographical memoir (see below) and *Illustrations of the Huttonian Theory*; vol. II, the *Progress of Mathematical and Physical Science*; vol. III, various papers on mathematics and physics, plus a "lithological survey of Schehallien" (in Scotland), all of which had appeared either in *Transactions of the Royal Society* or *Transactions of the Royal Society of Edinburgh*; and vol. IV, various biographical accounts and reviews, a biography of James Hutton being particularly important. His works are listed in the British Museum *General Catalogue of Printed Books*, CXCI, cols. 378–379.

II. Secondary Literature. The source for details of the life of Playfair is F. Jeffrey, "Biographical Account of the Late Professor Playfair," prefixed to J. G. Playfair's ed. of the *Works* (see above). See also B. B. Woodward, in *Dictionary of National Biography*, XLV (1896), 413–414. In reviewing Hutton's theory, Playfair's *Illustrations* is nearly always referred to, since it is an essential part of the authoritative exposition of Hutton's principles. See particularly A. Geikie, *The Founders of Geology* (London, 1905), 280–316; and "Lamarck and Playfair," in *Geological Magazine*, **43** (1906), 145–153, 193–202; C. C. Gillispie, *Genesis and Geology* (New York, 1951; repr. 1959), *passim*; and R. J. Chorley *et al.*, *The History of the Study of Landforms* (London, 1964), 57–68. Playfair's original contributions to geological knowledge are reviewed in J. Challinor, "The Early Progress of British Geology—III,"in *Annals of Science*, **10** (1954), 107–148, see 137–143.

John Challinor