

sandstones, ironstones, and coals which go to form what are termed Coal-measures, were of marine origin, do not mean more than that these rocks were deposited, and that the vegetation which formed the coals was grown, in the waters of large estuaries and lagoons, or along the shore-line of some continent. In this sense the marine origin of coal can be understood, and the scant nature of its fauna explained. The brackish water to be found under such circumstances will account for the small number of species and the large number of individuals usually met with fossil in nearly all coal-fields.*

LXII. ADDRESS *in MEMORY* of JAMES SMITH, ESQ., of *Jordan Hill*, F.G.S., *late President of the Society*, delivered by REV. HENRY W. CROSSKEY, on the *Evening of February 7th, 1867.*

I HAVE been requested by the Council to address you this evening, in order to express our deep sense of the loss this Society has sustained by the death of our lamented President, and our high regard for the services he has rendered to the cause of scientific research.

Mr. Smith, who was born in the year 1782, and died on the 17th January, 1867, was President of the Archæological Society as well as of our own Society; a fellow of the Royal Society, and a member of the Geological Societies of France and London. He was educated in the University of Glasgow. His taste for natural history was developed in connection with his love of yachting, and for many years he was the most adventurous, if not the only yachtsman, in the West of Scotland. In 1866, in company with Professor Milne and Dr. Ure, he made a voyage to the Isle of Skye in a small vessel of about 12 tons burden.

Serving as an officer in the Renfrewshire Militia, he was on duty at the Tower of London during the imprisonment of Sir Francis Burdett, and after the peace visited France and Italy.

Among the Institutions of Glasgow, he regarded the Andersonian University with especial interest, and from the year 1830 until his death, continued to take an active part in its management. He was elected to its presidency and enriched the Institution with many liberal gifts. He was the founder of its Natural History

* Unavoidable circumstances have hindered us from giving the concise account of the species that we had intended to draw up.—T. R. J. and J. W. K.

Museum, and deposited in its charge large collections both of British and fossil shells. He formed a very complete collection of Scotch coins which he also presented to the Museum.

From time to time various papers and works upon Archæology, Scriptural Criticism, and Geology, proceeded from his pen, giving evidence both of the breadth of his interests, the industrious accuracy of his observations, and the acute and scholarly cast of his mind.

In the field of Scriptural criticism, he published an essay on "The Sources of St. Luke's Writings," and a work on the Voyage and Shipwreck of St. Paul. The last named work has become a standard authority upon the subject on which it treats, and is so thoroughly exhaustive that it is not probable it will ever be superseded.

Among his antiquarian papers is an account of the Vitrified Fort on one of the Burnt Islands in the Kyles of Bute, which was discovered by Mr. Smith during one of his yachting expeditions. This paper was published in the transactions of the Edinburgh Antiquarian Society.

The field of Post Tertiary Geology, however, was the favourite ground of our late President's investigations. In some degree, indeed, the name of Mr. Smith marks an epoch in the development of this branch of geological science. He was the first to maintain and prove by a long series of minute, patient, careful observations, that a colder climate preceded the present. This conclusion was not arrived at by a chance guess, as a lucky speculation, or by the happy stumbling of the foot against a fossil, but it was reached step by step, and is notable as the result of inquiries pursued with skill and devotion, and directed by a true spirit of scientific research.

Mr. Smith's earliest geological paper, entitled, "An Indication of Changes in the Elevated Beds of Sea and Land in the West of Scotland," was read to the Geological Society of London, Nov. 16th, 1836, and was followed by a series of communications on the phenomena of the elevated marine beds in the basin of the Clyde; in the course of which he pointed out the arctic character of the shells contained in the upraised clays of the West of Scotland, and drew the conclusion that the climate as well as the level of the country has changed, while also attempting a classification of the various strata.

Mr. Smith having resided for a considerable time in the south of Europe, published accounts of the Geology of Madeira and Gibraltar, with a view to describe the changes which have taken place in the fundamental rocks of those districts during the newer pliocene or post tertiary periods. His last communication was on a Split Boulder in the Isle of Little Cumbrae, read to the Geological Society of London, Feb. 26th, 1862.

The whole of these papers have been collected and published in one volume, entitled, "Researches in Newer Pliocene and Post Tertiary Geology."*

This volume of Mr. Smith's collected papers contains the history of a discovery, and is valuable as much for the mental characteristics it unfolds as for the facts it details. It shows the patient, anxious, toilsome steps by which his conclusions were reached. We see the operation of the author's mind as he passes from observation to observation, making no effort and having no desire to assert any theory of his own against the reality of nature. Scientific work, carried on in a spirit at once so single-minded and truthful and exact, manifests qualities which are as much attributes of character as endowments of intellect. It demands the intellectual patience which can wait for results. There is a patience of the intellect which is akin to the moral patience with which the heart can upbear against long and weary delays in the fulfilment of a cherished hope. It is the patience with which a man, pressing towards discovery, fairly weighs and balances fact against fact in an even scale, whether opposing or favouring the secret tendency of his personal speculations. With patience there must also be intellectual self-denial—that is, the rare power which can deny what we *wish* to be true, for the sake of what *is* true—and abandon results, achieved, perhaps, by the toil of years, when the sacrifice is asked by a newly-discovered fact. There must be the persistent labour which can endure to work for months to ascertain matters which can be stated in an hour; and to write a volume of notes which, when completed, can be summed up in a page. And persistent labour never does justice to itself unless it is united with the high capacity of being able to confess ourselves in the wrong, and of retracting what we have once stated when we see our error, although we vainly imagine a reputation for scientific accuracy involved in the uniformity of our papers.

* Glasgow, John Gray, 1862.

There must, moreover, be the modesty which can learn more willingly from others than assert for itself, and which can never free itself from the conviction that the best we can do is necessarily imperfect and certain to be revised.

Every man attempting to follow science will do well to cherish the modest conviction expressed by Mr. Smith when writing on the changes of the earth's crust:—"However numerous the changes; however vast the intervals; they form but one page in the voluminous history of the earth which geology unfolds. That page has been but just opened, and the few feeble characters inscribed upon it by so early a labourer must necessarily be imperfect."

The volume of our late President's researches abundantly manifests these qualities of which I have spoken—intellectual patience and intellectual self-denial; persistent industry and capacity to advance beyond first-formed conclusions, united with a modesty singularly admirable in yielding to facts as they unfolded to patient observation their exact order, and rendering to their legitimate authority a due submission—qualities which, in Mr. Smith's case, bore the fruit of a happy discovery, and in all cases render the pursuit of science a noble education of the character. The history of Mr. Smith's investigations can be briefly sketched in its salient features and chief directions.

I.—*The last changes in the relative levels of land and sea in the British Islands* attracted his study.

We must cast our minds back to the day when the presence of modern shells in localities even distant from the sea was ascribed to the tumultuous and transitory effects of water. The first step taken in advance of this notion by Mr. Smith was to point out that there are many beds in the West of Scotland which it is impossible to ascribe to violent action, and which are considerably elevated above the sea level. Shells are to be found in situ and in regularly stratified beds at levels of, 25, 50, 70, 120, 350 feet above the sea, and the elevation of the land thus becomes an ascertained fact.

In the first instance, Mr. Smith discriminated two divisions only in these beds, viz., (1), The till, for the most part without shells, and these, when occurring, fragmentary; and this "till" he ascribed to diluvial action. (2), The deposits of clay and sand, containing shells in situ and proving the elevation of the land.

The next noticeable step was taken when Mr. Smith pointed out *signs of subsidence as well as of elevation.*

He described sections in which a marine carse clay rests upon a submerged forest. The evidences of depression proved no less conclusive than those of elevation; and the general fact was thus reached, that no single movement, whether of elevation or depression, can account for the phenomena of the post tertiary beds in Scotland.

The next problem was to examine the *date of these last changes* and ascertain if any approximate conclusion could be reached. Three points upon which calculation can be based struck Mr. Smith. (1), The position of the Roman wall in reference to the sea. (2), The rate of wearing action of the sea upon substances such as trap and sandstone of unequal consistency. (3), The signs of the first appearance of man. Upon each of these matters controversy is now busy; and it is no small honour to our President that he asked the questions which will have to be answered by a succeeding generation. It is a remarkable sign of the progressive character of his mind that, in 1862, he declared himself satisfied that changes of level have taken place since the British Islands were inhabited by man—a position at variance with his earlier convictions.

II.—Mr. Smith's researches had frequent reference to the *nature and causes of the Old Till or lower Boulder Clay.* Upon this point, as others, his opinions gradually developed themselves, and we can trace their stages in successive papers.

At first he deemed the Till diluvial in its origin, considering water, when rolled by earthquake shocks, a sufficient cause. An examination of the scratched boulders contained within the Till, which he made in company with Agassiz, compelled the conviction that they must be ascribed to glacial action, either in the shape of icebergs or glaciers. The study of the successive papers upon this subject in Mr. Smith's volume is most instructive as a lesson in the gradual growth of true conviction.

Difficulties are raised; minute details referred to; fresh examinations made; until at last the old diluvial theory is surrendered, and the action of ice taken into due account.

Mr. Smith also raised the question as to the *direction of the force* by which the Till was formed. He examined and classified the different rocks which the boulder clay near Glasgow contains, and, tracing them to their source, found they must have been swept

from the north-west. This kind of observation is familiar enough to us at the present day, but we must never forget that the commonplace facts of one generation were the original discoveries of the preceding.

III.—The chief division under which Mr. Smith's papers may be classified, contains *his examination of the shell-bearing beds of the glacial clays on the west of Scotland.* -

In his early papers, all the shell beds were classed together. They were not discriminated into groups of earlier and later date, and were only regarded as proving elevation of land, without any recognition of altered climate. Shells from the raised beaches and the older glacial clays were mixed together in one list. It was perceived that several species found fossil were not identical with living forms, but these were pronounced simply extinct, and their existence in the waters of the Arctic Sea was not suspected.

The conclusion that the species supposed to be extinct were in reality living Arctic forms was first suggested to Mr. Smith by observing the identity of many of the shells most common in the Clyde beds with those described by Lyell, as fossil, at Uddevalla, and figured in his paper on the elevation of land in Sweden, in the Philosophical Transactions for 1835.

With characteristic activity, Mr. Smith proceeded to make as complete lists as possible, both of the living shells of the Clyde and the fossils of the elevated beds; and the unknown specimens having been submitted to M. Deshayes, he observed, that the whole of those examined by him, which are still to be found recent, although not in the British seas, occur in northern latitudes. The paper read by Mr. Smith to the Wernerian Society, 26th January, 1839, was the first in which it was maintained that a colder climate preceded the present.

Further researches brought evidence that there are two very distinct deposits in the elevated marine beds, differing both in fauna and climate, and separated by wide intervals of time. Mr. Smith accordingly assorted his first catalogue into two parts—the older fossil shell bed, containing arctic species; and the younger, containing no species not found living in the present seas. Separate lists were drawn up, and the proof of climatic change became complete.

These happy discoveries, gentlemen, will connect our late President's name with the history of geology. No geological manual

can be written without its chapter on the Glacial epoch; and the first page in this chapter must be ascribed to the hand of Mr. Smith.

Many difficulties are undoubtedly unsolved, but it is a rare honour to have been permitted to raise problems so vast as those involved in the existence of an age of ice in Scotland.

One word in conclusion. In this great city there have dwelt many good and illustrious men, whose memories are cherished with reverent regard.

Now there passes from our midst the philanthropist, whose purse has been as open as his heart, and his heart as tender as his soul devout.

Now the poet is taken from us, who learnt music in the midst of our troubled discords, and, through the inspiration of genius, could make melody of this noisy city life.

Now we lose the man, skilful, it may be, in mechanical device, cunning in hand as thought, raising a machine almost into vital existence, and producing a work of genius, as harmonious in plan and parts as a poem, out of iron and brass.

Be it our privilege, gentlemen, as inefficient but not unloving students of a great science, to remember with honour one whose life was adorned by enthusiasm for its service.

In this busy community, there is need for every varied pursuit. Star differeth from star in glory, but we may be permitted to say, that he serves his race who deepens and widens the thoughts of men; and that whosoever can make men love better and follow more faithfully even the most abstract of scientific studies, not only diffuses a pure taste which can save from baser cravings, but ennobles character, by bowing down the heart in lowlier reverence before Him who fastened the foundations of earth, and who hid the corner stones thereof, when the morning stars sang together, and all the Sons of God shouted for joy.

LXIII. NOTES on some FOSSIL CRUSTACEA, and a CHILOGNATHOUS MYRIAPOD, from the COAL MEASURES of the WEST of SCOTLAND. By HENRY WOODWARD, F.G.S., F.Z.S., of the British Museum.

(PLATE III.)

I REGRET exceedingly that so long a time has elapsed since my attention was first drawn to these specimens by Mr. Farie, before communicating my remarks upon them to the Geological Society