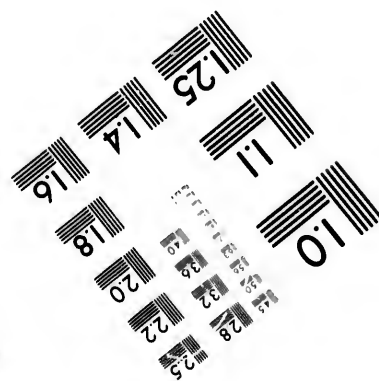
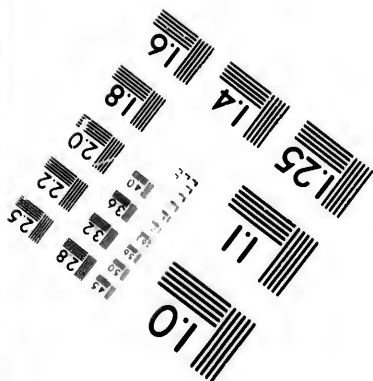
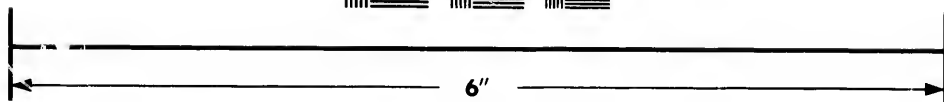
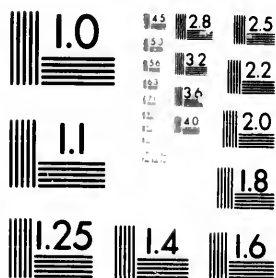


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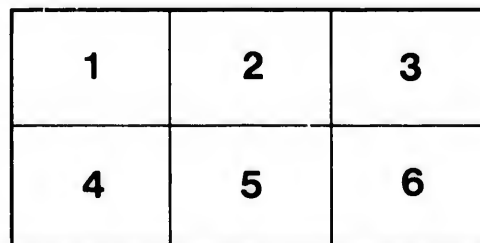
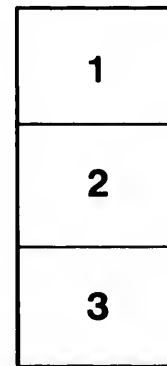
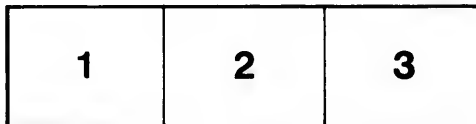
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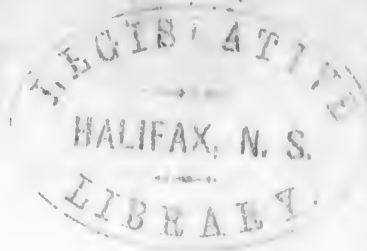
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RECOLLECTIONS OF SIR CHARLES LYELL.

Being the Annual Presidential Address of the Natural History Society of Montreal, for 1875, delivered by PRINCIPAL DAWSON, LL.D., F.R.S.

I propose to devote the greater part of this address to memories of a man whose death may almost be said to close an era in the history of geological progress, as the publication of his greatest work, the *Principles of Geology*, may be held to have begun an era in the study of that science, whose goal of to-day will ever be its starting point for to-morrow. Sir Charles Lyell, the greatest geological thinker of our time and nation, died on the 22nd of February, in his seventy-eighth year. He was born at Kinnordy in Forfarshire, on the 14th of November, 1797, and graduated at Oxford, in 1819. He studied for the Bar, and began the practice of his profession; but his mind was already occupied with inquiries as to the structure of the earth, stimulated apparently by Buckland's lectures, to which he had listened at Oxford. In 1824, he became an honorary secretary of the Geological Society of London, and for a time he was Professor of Geology in King's College, London. He was elected, for the first time, President of the Geological Society in 1836.

Sir Charles received the honor of knighthood in 1848, and was raised to a baronetcy in 1864. He had the degree of D.C.L. from Oxford and that of LL.D. from Cambridge. He was thrice president of the Geological Society, and once of the British Association.

He married in 1832 the eldest daughter of Leonard Horner, himself a good geologist, and a friend and helper of Lyell in his earlier work; and his wife not only graced his home and sedulously attended to all the wants and interests of a man too devoted to his specialties to give much attention to the ordinary affairs of life, but shared the fatigues of his journeys, and gave no small help in many of his works, being herself well acquainted with natural history and an accomplished linguist. Her death, less than two years ago, deprived his old age of its chief earthly stay.

In January, 1830, the first volume of his *Principles of Geology* appeared, and was followed by the second in January, 1832, and by the third in the following year. This work has reached its eleventh edition; and with the *Elements or Manual of Geology*, which followed, it may be said to have done more than any other book to shape the geological science of the time. More especially the doctrine of reference to existing causes for the explanation of all geological phenomena, at once removed theoretical geology from a speculative to an inductive basis, and laid a stable foundation for a history of the earth. Though Lyell published many detached geological memoirs, and also gave to the world very instructive and interesting narratives of his travels in America, and latterly summed up the facts and conclusions at present reached with reference to the latest geological period, in his "*Antiquity of Man*," his great fame must rest on his *Principles of Geology*, and on the effect of this work in giving form to geological science.

While the name and fame of Lyell belong to the world, we in British America and our brother geologists of the United States have some special cause to revere his memory, because of his world-wide grasp of the subjects he studied, and because of his eminent services to our own local geology and geologists; and, as examples of these, I shall take the liberty of referring to some of them which came under my own personal observation.

The visits of Sir Charles Lyell to America were three in number, though detailed narratives of two only were published. The first, in 1841, was made in pursuance of his determination to verify for himself, as far as possible, all geological facts to which he had occasion to refer—a determination justified not only by the love of truth, but by his own great powers of appreciating the nature and relations of phenomena, and of presenting

them to the minds of others. He had, on this occasion, an invitation to lecture for the Lowell Institute of Boston, which kept him some time in that city; but he took time to travel very extensively both in Canada and the United States.

His second visit to America was made in 1845, and on this occasion, he merely called at Halifax, and did not travel in British North America. He devoted his whole time to the United States, and more especially to the South. In 1853, he was named one of the Commissioners to the Great Exhibition in New York, and on this third visit he landed in Halifax and spent some time in Nova Scotia and New Brunswick.

I had the pleasure of first meeting Sir Charles in 1841, when he spent a few weeks in the Maritime Provinces of British America. I had just returned from the University of Edinburgh and from the somewhat careful training in mineralogy and lithology of the veteran Jameson, and had already given some time and study to the Carboniferous rocks of my native province. In these circumstances, the visit of Lyell was most opportune for me; and from my local knowledge, I was able to give him some aid in unravelling those complexities of the Carboniferous beds, to which at the time his attention was earnestly directed. I accordingly accompanied him in the remainder of his tour in Nova Scotia, and after his departure, followed up his work in districts which he had been unable to reach. We have met many times since, both in England and in this country, and have regularly corresponded down to within a very short time of his death; and I have ever found him a warm friend, and intensely interested in all that concerned the growth of natural science in this country.

The benefits rendered by Sir Charles to American Geology in his several visits to this continent, it would not be easy to over-estimate. At the time of his first visit, few English geologists had seen those great breadths of the older and of the more recent formations by which this continent is distinguished, or had the means of realizing for themselves the resemblances and differences of the formations on the opposite sides of the Atlantic; and American and British workers in these subjects were little known to each other. The visits of Sir Charles did much to remedy all this. His own mind was filled with those grander aspects of geological phenomena which appear in America. He brought into correspondence with each other those

workers in science, whom his intuitive tact perceived to be suited to give mutual aid. In British America, in particular, his agency in this way was very valuable in bringing together the widely-separated cultivators of science, and in linking them with the scientific movement of the mother country.

Nor were his visits barren of purely scientific results. He may have made few discoveries of new facts,—and he had not time to enter into detailed stratigraphical studies;—but in a thousand instances he cast new light on obscure facts, and gathered into a harmonious union detached fragments of evidence, and suggested new conclusions and interpretations. Of this character were his re-arrangement of the Carboniferous rocks of Nova Scotia and New Brunswick; and the clear conceptions which he formed of the nature and origin of our Post-pliocene formations, and which are still, I think, in advance of those currently taught on this side of the Atlantic.

Limited though his time for observation was, he always seized the salient and important points of any formation or locality; and I have often been struck with the truthfulness and completeness of the sketches which he gave of phenomena with reference to which his opportunities of collecting information were very imperfect.

In these American researches, the great gifts of the man were brought out in a light somewhat different from that in which they appear in his general works. The main distinction between Sir Charles and most of his contemporaries, was his eminence as a thinker, whether in inductive or deductive reasoning. Like most of the English geologists of his time, he had received less training in the characters of minerals and rocks than that which the more severe schools of science exacted, and his imperfect vision was a great hindrance in field work, and sometimes even a source of personal danger; but when facts, however complex, were once obtained, they grouped themselves in his mind in their natural relations, with an unfailing certainty, while their connections with all the other parts of his vast stores of knowledge and the general conclusions deducible from them, came out with a degree of clearness always beautiful, and often even startling.

Another quality of his mind was the fresh and vivid interest, almost childlike, which every new truth awakened in him. This feeling is more or less that of every true naturalist. It depends

on the clear perception of what is presented to us, and on the keen realization of its relations to things previously known, and perhaps still more on the sudden breaking of those new relations upon the mind as if with a flash of divine light. I well remember how, after we had disinterred the bones of *Dendroperpeton* from the interior of a large fossil tree on the Joggins shore, his thoughts ran rapidly over all the strange circumstances of the burial of the animal, its geological age, and its possible relations to reptiles and other animals, and he enlarged enthusiastically on these points, till suddenly observing the astonishment of a man who accompanied us, he abruptly turned to me and whispered: "The man will think us mad if I run on in this way."

An allied feature of his mental character was the readiness with which he accepted new conclusions and relinquished without regret views which he might have long held, when he perceived them to be shaken or untenable. He seemed wholly free from that common failing of men of science which causes them to cling with such tenacity to opinions once formed, even in the face of the strongest evidence. This quality eminently fitted him to be the expositor of a rapidly advancing science, and also to be the patron and helper of younger and less eminent men, and was connected with that warm and earnest interest which he ever felt in the progress of knowledge, and with the deference with which he received new facts and suggestions from any quarter.

These qualities, apparent in his connections with American Geology, were equally valuable in his relations to science in its general aspect. A man so gifted, fortunate in his genius, his education, his outward circumstances, and in his appearance on the stage at a time when Geology had gathered in some of its greatest harvests of facts, and was waiting for a master mind to arrange them, had a great opportunity, which Lyell had the energy and ability to seize. He was thus able to become the guiding mind among his contemporaries in geological theory, and to hold his pre-eminence down to the end of his life, and through all the great changes which occurred in the rapid development of the science. For nearly 45 years, his works have been the text-books of geologists, and though the great impetus which they primarily gave has thrown the study of the earth forward into an entirely new position:—the last editions of the *Elements* and *Principles* are still in the van of the science.

The position which he thus occupied is one to which he was in every way justly entitled. His large and judicial mind had always a clear perception of the true method of natural history. He saw that the foundations of our knowledge of geology were to be laid in extensive and accurate collections of facts, and in reasoning on these by severely inductive methods. This idea he carried out in his *Elements of Geology*. But in his *Principles* he opened up a new field, not as has been crudely conceived by some commentators on his work, one of the nature of deduction as distinguished from induction, but rather another inductive investigation, leading to general conclusions as to the changes now in progress, in order that by a fair use of analogy a key might be found to the interpretation of the facts and conclusions obtained by the study of the geological monuments of past ages. He has himself well stated this view of the case in the preface to the tenth edition of the *Principles*.

Viewed in this way, the Lyellian Geology rests on two inductive bases—the first relating to the facts discoverable in the earth's crust, and the second to the changes now in progress under our observation—and the connection of these by an analogy founded on identity of causes or conditions and identity of effects. This mode of treating the history of the earth was especially that of Lyell, and it was this that constituted his greatest contribution to the growth of modern geology.

Injustice has been done to the Lyellian method by two misconceptions, propagated perhaps by injudicious friends rather than by opponents, and which have arisen from a failure to enter into the grand comprehensive views of this great reasoner.

One of these is the representation that Lyell was thoroughly uniformitarian, in the sense of maintaining that similar changes had been taking place throughout all geological time. It is true that he objected to any explanation of geological changes by imaginary cataclysmus not warranted by observation of similar facts; but no one was more ready than he to receive any evidence of change, or physical or organic action, whether sudden or gradual, as a geological course, provided it could be shown to be or to have been a natural fact. Farther, no one was more fully impressed with the continual change and progress in nature, and with the necessity of taking into account the different conditions of different geological times, in applying any modern cause to account for ancient phenomena.

A second and still more mischievous misapprehension is that of regarding his method as similar to that style of analogical reasoning which Spencer and Darwin have made so current in our time. When Lyell strove to illustrate the conditions of the Coal period by those of the great Dismal Swamp, for example, his argument was one of analogy, but an analogy in which the main conditions could be proved to be identical. In both cases they were swamp conditions, though separated by a great lapse of time. He never would have reasoned, like Spencer, that the evolution of an egg explains the evolution of animals in geological time; because in this case the similarity of conditions which can alone give value to a natural analogy is wholly absent. Nor does the Lyellian philosophy properly admit the assumption, as a *vera causa* of past geological change, of processes supposed to be going on, but so slowly that human experience fails to obtain any measure of them, or even any certainty as to their reality. It is true that, in the later editions of the Principles, Sir Charles admits the force of Darwin's arguments for the transmutation of species, and devotes large space to their exposition; and he states, as his general conclusion, that Darwin, "without absolutely proving this, has made it appear in the highest degree probable;" but I do not find that he ever regarded these brilliant speculations as occupying the same stable ground with his own grand general conclusions as to the persistency of existing causes in geological time. Lyell, in short, while a uniformitarian rather than a cataclymist, held to uniformity not of effects, but of the general laws of causation; and the analogies by which he sought to connect modern changes with those which had left their monuments on the earth's crust, had nothing in common with those on which theories of transmutation of species have been based.

It is always an interesting inquiry in the case of a great student of nature, to ask what position he took in regard to those higher problems which directly affect man in his mental, moral and spiritual nature. There is nothing in the study of nature to withdraw a man from sympathy with his fellows; and men of science who have so shut themselves up in their specialties as to take no interest in the general welfare and progress of society, have necessarily failed to secure for themselves and their subjects the hearty interest of mankind. In these respects, Lyell was characterized by the same breadth which appears in his scientific

investigations and reasonings. He was a warm personal friend, and full of sincere sympathy with all that concerned those he loved. He was active and earnest in promoting education and the diffusion of knowledge, and he took a lively interest in all movements for improving the social and political condition of mankind. He was quite free from that tendency to attack or sneer at everything that other men hold sacred, which characterizes some of the advanced writers of the day. He neither tormented himself with the gloomy idea that men looked askance upon him and desired to persecute him, nor did he desire to make any other man a martyr to his faith. In the earlier editions of the Principles, he closed the work with a few paragraphs of "Concluding Remarks," in which he repelled the imputation that his doctrine of modern causes was equivalent to the assumption that "there never was a beginning of the present order of things;" and he takes occasion to state his doctrine of the relation of natural science to religion in the following words, which, I find, remain unchanged in the last edition:—

"We aspire in vain to assign limits to the works of creation in space, whether we examine the starry heavens or that world of minute animalcules which is revealed to us by the microscope, we are prepared therefore to find that in time also the confines of the universe lie beyond the reach of mortal man. But in whatever direction we pursue our researches, whether in time or space, we discover everywhere the clear proofs of a Creative Intelligence, and of his foresight, wisdom and power. As geologists, we learn that it is not merely the present condition of the globe which is suited to the accommodation of myriads of living creatures, but that many former states also were adapted to the organization and habits of prior races of being. The disposition of the seas, continents and islands, and the climates have varied; the species likewise have been changed, and yet they have all been so modelled on types analogous to those of existing plants and animals, as to indicate throughout a perfect harmony of design and unity of purpose. To assume that the evidence of the beginning and end of so vast a scheme lies within the reach of our speculations, appears to be inconsistent with a just estimate of the relations which subsist between the finite powers of man and the attributes of an Infinite and Eternal Being."



