CYCLICAL DELUGES.

OPINIONS OF THE PRESS.

"THE EXAMINER," JUNE 10, 1871.

Mr. Walker says with truth that "upon no one subject of speculative thought are the opinions of men more divided than upon the immediate agency by which those stupendous changes have been wrought that have undoubtedly taken place in the relative positions of the land and water which together form the covering of the world we live in," and it is the object of his work to establish a theory upon this point which has the merit of much originality and of which the study cannot fail to be both interesting and profitable.

The subject is of too intricate a nature to admit of discussion in a short notice, but Mr. Walker writes in a style which enables the least scientific of readers to follow him; and we cordially recommend this little book as containing the thoroughly well-expressed views of an original mind upon a topic of inexhaustible interest.

"THE BOOKSELLER," MAY 1, 1871.

Mr. Walker has aimed, and with indisputable success, at imparting in this volume the latest and most advanced knowledge regarding the chief geological phenomenon of the globe. He gives us physical facts and mathematical deductions in support of the views advanced; and, although the opinions he sets forth may not find general acceptance, their expression will not fail to indicate a field of fresh inquiry, and elicit new modes of thought which shall reconcile some of the geological puzzles which constitute our present accepted system of geology with those phenomena that reason may assure us are indubitable facts. In the four parts into which the work is divided the author's system is fully developed and the theory of cyclical deluges ably advocated.

"THE AGE" (PHILADELPHIA), JULY 20, 1871.

This volume is intended to serve two purposes—first, to meet the need of advanced geological knowledge, and, secondly, to exhibit a theory concerning "Cyclical Deluges." The information given in these pages is new and entertaining, and has been gathered with evident care and discretion. The work, also, merits the praise considerable originality. The theory advanced relates to the formation of coal beds. The present theory is that these coal formations are the remains of vegetable matter growing *in situ* and solidified by compression. Against this theory, the author instances the fact of decay as too rapid to allow of the formation. As a substitute, he advances the explanation that the deposits were made by inundations gathering material in transition, and leaving it when they subsided. These inundations, he holds, are periodical or "cyclical," and follow whenever the earth's centre of gravity is removed by the alteration of the position of its axis. By the displacement and gradual approximation of the waters of the Southern Ocean to the North will take place until they will make one grand rush from their position. This change of place of the centre of gravity and its accompanying deluge depend upon the elliptic form of the earth's orbit, and also upon the laws which govern the position of the earth's axis in the course of revolution. The axis, it is calculated, shifts about once in every 10,500 years. Consequently a new deluge may be expected in about sixty-seven centuries. Of the style of the writing we can give the most unqualified approval. The choice of words is scholarly and appropriate, and the sentences are clearly arranged and nicely balanced. Although dealing with abstruse subjects, the work is most intelligible and instructive. While the scientific portions are on matters open to dispute, the reverent and earnest tone merits the warmest approbation, while its ability demands the respect of the scientist as well as the interest of the mere seeker after curious information.

"THE CHRISTIAN UNION" (NEW YORK), AUGUST 23, 1871.

Where he (Mr. Walker) attacks current theories of physical geography we are able to follow him with a degree of satisfaction. He renders the Noachian more reasonable than any of the arguments against it.

"THE BRITISH PRESS," DECEMBER 22, 1871.

This is the title of an ingenious dissertation on cyclical deluges. It also embraces a well-argued theory founded on geographical facts on the formation of carboniferous mineral. Mr. Walker claims to be the first writer who has pointed out the remarkable geographical position occupied by the coal-fields of the world as bearing testimony to the theory of deluge epochs, as demonstrated by M. Alphonse Adhemar, in his "Révolutions de la Mer." . . . How these alternate deluges affect the race of man, physically and historically is ably commented upon, the writer showing how the whole face of arts, sciences, civilization, everything, will be changed, or recommenced anew, "the human remnant falling back into benumbing barbarism, until subsequent generations essay the first step in the ladder of improvement and slowly climb its difficult height, each step an age of centuries." . . . Scientific and non-scientific readers will, we feel sure, derive both pleasure and profit from a perusal of this well-written book.

"ENGLISH MECHANIC AND WORLD OF SCIENCE," NOVEMBER 24, 1871.

This little book purports to be an explication of the chief geological phenomena of the globe by proofs of periodical changes of the earth's axis, and embraces a theory, "founded on geographical facts," on the true geological formation of carboniferous mineral. The author thinks that in his pages a key will be found to unlock many of the mysteries which at present beset the study of terrestrial phenomena; he considers, from a review of geological facts, that "Noah's flood" was occasioned by the sudden departure of the waters of the north towards the Antarctic pole, and that this was merely one of a series of cyclical deluges, the next of which is to proceed from the south pole at about sixty-three centuries hence, if it is not precipitated by contingencies at present unforeseen. The cause of these deluges is attributed by Mr. Walker to a change in the inclination of the earth's axis. "The earth, being an oblong spheroid, is slightly swollen or bulged out at the equator, and the sun's attraction, acting on this swelling, has the effect of changing the inclination of the axis." This theory is, of course, founded on the calculations of Adhemar in his "Revolutions de la Mer." In the year 1248 B.C. the north pole attained its maximum duration of summer heat. Since then the ice has gradually increased, and will continue to increase till it again covers the greater part of the northern hemisphere, when the cataclysm will occur forming the coming deluge to which we have referred. This is to be about 7,382 of our era. At the present time the sun shines seven days longer at the south pole than at the north, and the consequence is an accumulation of ice at the north and a decrease at the south pole—a fact which, it is said, has been observed by navigators in those parts. These changes are alternate, and hence form the cyclical deluges of our author. Mr. Walker's idea of our coal formations may be gathered from the following passage: "If, as geologists assert, coal is derived from vegetable matter grown *in situ* and then submerged, how are we to account for the Arctic regions being so abundantly provided with coal that it is found cropping out from the sides of the sandstone cliffs, and water-worn nodules of that mineral cumbering the beaches over large areas? Melville Island is one great coal-field, like Newfoundland and Prince Edward's Island. Thus, while those inhospitable shores are seamed with coal, the genial climate and former forest-lands of Essex, Kent, Sussex, Middlesex, Hants, Bucks, Oxfordshire, Suffolk, Norfolk, &c., have not a trace of mineral fuel . . . . Here we have deductive proof that the above districts, having been cut off from sharing deluge, Arctic timber-drift (on account of the Straits of Dover being then closed), are without bituminous fuel. On the other hand, the Arctic region, with its prolific mines of coal and fossil ivory, has been, from one deluge epoch to another, supplied by the rifted forests of sunny lands, superimposed, in many cases, on the swamp vegetation of the period." The author, who has travelled extensively, marshals a goodly array of facts in support of his theory in a clear and concise style, and those who do not agree with him will at least read his little book without a feeling of *ennui*.

"THE MELBOURNE ARGUS," JUNE 6, 1871.

The author has grouped together, a good many interesting and striking facts in confirmation of the theory, and he succeeds in conveying a very fair idea of the nature and succession of the principal geological phenomena of the globe.

CYCLICAL DELUGES:

AN EXPLICATION

OF THE CHIEF

Geological Phenomena of the Globe,

BY PROOFS OF

PERIODICAL CHANGES OF THE EARTH'S AXIS.

EMBRACING

A THEORY, FOUNDED ON GEOGRAPHICAL FACTS,

ON THE

TRUE GEOLOGICAL FORMATION OF CARBONIFEROUS MINERAL.

With an Engraving.

BY

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LONDON:

W. J. JOHNSON, 121, FLEET STREET.

CALCUTTA: THACKER, SPINKS, & CO.

BOMBAY: THE BOMBAY EDUCATION SOCIETY.

MELBOURNE: CHARLWOOD & SON.

1871.

PREFACE.

THE want of a book which should impart advanced information regarding the chief geological phenomena of the globe, derived from the latest discoveries, whether physical facts or mathematical inductions, has been the incentive on the part of the Author to produce this work, which he hopes will not only merit public favour, and lead to a general adoption of the opinions set forth, but that it will also open up fresh fields of inquiry, and elicit new modes of thought, which shall reconcile some of the geological puzzles which constitute our present accepted systems of Geology, with those phenomena that reason may assure us are indubitable facts.

The Author is conscious that he will meet with dissentient remarks from leading geologists; but he trusts that even they may be induced to pause

in holding fast to their theory that carboniferous formations are the result of vegetable matter grown *in situ*. As far as the Author is aware, he claims to be the first writer who has pointed out the remarkable *geographical* position occupied by the coal-fields of the world as bearing testimony to the theory of deluge epochs, as demonstrated by M. Alphonse Adhemar.*

Geologists admit the advent of Man on the earth from far distant ages, yet we universally find him a savage, except in Central Asia, where the "Rig-Veda," said, by learned Sanscrit scholars, to be the oldest record of man,† exhibits the Hindoos as possessing an elevated philosophy, a yearning aspiration to adopt a Godhead worthy of their holy adoration, and who then possessed a civilization which casts into the shade that now ruling, after a lapse of fifty centuries. If we also take into consideration the arts and sciences which must have accompanied the high civilization of that ancient people, may we not reasonably inquire why its waves of divergence had not spread in wider circles than we know

* "Révolutions de la Mer." † 3,000 B.C.

them to have done, had there not been some great benumbing catastrophe which overtook man, and which only permitted a remnant to escape in the quarter of the globe indicated? It is also remarkably significant, and especially so in the book referred to, that, going back to a period of forty centuries, there ever hangs an impenetrable curtain of darkness, behind which we cannot further explore the early history of Man; although directly on this side of that gulf of silence, we find him surrounded with a high civilization, accompanied with a holy, lofty, and sublime worship of one Supreme Being. How then, we may fairly ask, are we to read this archæological enigma, except by the adoption of the theory of cyclical deluges which have left so many acknowledged landmarks of their diluvial agency?

In the following pages the Author believes that a key will be found to unlock many of the mysteries which at present beset the study of terrestrial phenomena; and that, amongst others, when the high civilization attained, in non-carboniferous portions of the globe, such as Central Asia, which

bespeaks a high antiquity, is considered in relation to the fact that at the sites of the coal-fields of the world *Man appears to have last emerged from barbarism*. The repellant Malthusian theory will no longer be received as an axiom, that "Providence has ordained periodical wars, and pestilence and famine, as the Divine instruments of checking the otherwise inevitable superabundant population of the earth." Who shall presume to set bounds to Infinity ?

CYCLICAL DELUGES.

PART I.

CYCLICAL DELUGES;

OR,

PERIODICAL CHANGES OF THE EARTH'S AXIS.

"HE THAT OPPOSES HIS OWN JUDGMENT AGAINST THE CONSENT OF THE TIMES, OUGHT TO BE BACKED WITH UNANSWERABLE TRUTHS; AND HE THAT HATH TRUTH ON HIS SIDE IS A FOOL, AS WELL AS A COWARD, IF HE IS AFRAID TO OWN IT, BECAUSE OF THE CURRENCY, OR MULTITUDE, OF OTHER MEN'S OPINIONS."
—*Daniel De Foe.*

EVER since the introduction of the art of printing, attempts have been made, by Copernicus and other philosophers, to impart to mankind a knowledge of the structure of the earth; but it was not until a modern era—the times of Galileo and Newton—that the true nature of the planetary system, and the consequent revolution of the earth on its axis, were mathematically demonstrated. Indeed, it is less than half a century since a decree of the Holy See, condemning as heretical the work of Copernicus "On the Revolution of the Celestial Bodies" was revoked by Pope Pius VII.; whilst in our own times, learned men are fiercely discussing the incompatibility of the Mosaic account of the Deluge of Noah with the phenomena presented by the researches of Science.

Our forefathers lived in times when it was

dangerous to attempt the clearing up of any mysterious natural phenomenon. Even a worthy bishop, more in advance of his age than his brethren, who had avowed his belief in the Plutonic theory of the antipodes, was denounced as a heretic by Boniface, the legate of Pope Zachary; and still nearer our own days, a Hebrew philosopher, Sarsa, was burnt at the stake for asserting the great antiquity of the world.

But the mists of ignorance have, of late years, been gradually dissipated; and that which, only yesterday, as it were, was involved in mystery, is already more than half revealed to our wondering faculties. The courageous thinkers of every land have rejected the old traditions, or modified them by the new light which science and inductive reasoning have supplied. The stores of facts, collected with admirable industry from the buried archives of past time, gave rise to theories of deep and deepening interest to every one who has a mind to think and a heart to feel; for, on the one hand, whilst theologians will permit of no theory which cannot be explained by the Mosaic account of the Creation and of Noah's Flood, it cannot be denied that, on the other, geologists have sometimes been hasty in their generalisations. Hence in the conflict between Science and Dogmatism, the true nature of the points involved has been mystified and

obscured. No doubt this arises, in some measure, from the different views taken of the same facts by different parties; but also, in no small degree, from the imperfect or limited observations of the same class of phenomena made by scientific men who have been engaged in the controversy.

All science may be said to consist of an aggregation of successive discoveries, giving rise to new phases of inductive reasoning; and the same facts in geological research, leading to the adoption of one theory in Europe or North America, might, even at the present day, conduce to an opposite, or at least modified conclusion, in Australia. Upon no one subject of speculative thought are the opinions of men more divided than upon the immediate agency by which those stupendous changes have been wrought that have undoubtedly taken place in the relative positions of the land and water, which together form the covering of the world we live in.

And it is to be regretted that geologists, in their explanations of some of the grand phenomena of the earth's historical features, have failed to carry conviction to the mind of the general student. Nay, can it be said that geologists themselves are satisfied with their own explanations? The answer is given in the fact that the most eminent among them are the most cautious in advancing theories,

and the least dogmatic in defending their opinions. From this may be inferred that much of what is called the science of geology is but founded upon erroneous deductions not supported by probable facts. The chief fallacies would appear to be due to the want of happy inductive theories which shall be most in harmony with the sought explanation of the phenomena under consideration. To give an example of our meaning, let us take the theory of our coal formations. Thus, because geologists find the stools of trees, with sometimes trunks, of the vegetation which really preceded our earliest coal formations, they arbitrarily conclude that mineral fuel grew *in situ*, became submerged, and was superimposed on the *Stigmaria* and other vegetation so often found on the floors of our coal-beds. They quote solitary instances of *sigillaria* standing erect in the bed as a proof that the imposed mass did really grow *in situ*, and thus became a capping to the first or most ancient vegetation of the coal period; whereas, as we hope to show further on, the vast thickness of timber-swathes necessary to form a thick seam of coal was furnished by deluge-riven vegetation foreign to the soil, and conveyed to its destination by the turbulent waves of Old Ocean. We have proof that in the coal period the earth had the same atmospheric gaseous constituents as at present. How else would vegetation thrive with-

out such being the fact? In modern days, when we can *see* the operations of nature—not guess them—we know that when a tree falls with old age, or is laid prostrate by the wind, it will rot, and part with its carbonaceous gases to be dissipated in the air, to feed other plants; for without the *gaseous spirit* be retained in the submerged plant, no coal will result. We cannot manufacture mineral fuel from vegetable earth from which the necessary gaseous vitality has fled; how then is vegetable matter growing *in situ* to be transformed into mineral fuel? Nature's law of decay could not have been held in abeyance to suit the occasion of the coal period.

The most eminent geologist of the age, Sir Charles Lyell, suggests that, possibly, the seas may repeatedly have changed their places; that they may have been all grouped at one time about the equator, at another about the poles; and he has presented us with maps illustrative of these supposed variations in the distribution of land and water. The common belief is, that for cycles of ages before the historic era, land and water were distributed in general, as they now are; as far as geological research has been pushed, the reverse of this is found to be true; for there is a great, significant, and hitherto unexplained difference between the northern and southern hemispheres.

If an explorer wander about England or the north of Europe, he is continually meeting with new deposits, and can trace his way backwards through the oldest tertiary sediment. Similar phenomena abound throughout the northern hemisphere. That the waters covered, for long periods, very large portions of all those countries since the *eocene* date, and have left indubitable traces of their presence and power, is indisputable; but there are few parts of the southern hemisphere to which the same statement can be applied; and if it be questioned whether the distinction between the north and south is thus definite and universal, at least it cannot be denied that it is very broad.*

* The learned Professor M'Coy, of Melbourne, whose practical knowledge of the strata of Australia renders him a high authority on the subject, observes that, "Nearly every book on general geology refers to the supposed fact of Australia not having been submerged since the Oolitic period; generally, when treating of the *Phascolotherium*, and other English Oolitic marsupials, arguing that the marsupial, and other characteristics of Oolitic faunæ, continue to exist in Australia, because it has not been submerged, and contains no mesozoic or late formations. This fallacy I have disposed of by discovering mesozoic strata, with *Ichthyosaurus*, *Pleiosaurus*, *Ammonites*, &c., and proving the superficial formations to belong to two tertiary periods. The gravels of our gold-fields show a flood here, as in Europe and North America, at that geological time. Raised beaches may be traced near Geelong, and there is evidence of the whole south coast rising and the north going down. The alternations of trap and gravel, with trees, of our gold-fields, are tertiary."

For, as the southern hemisphere indicates the absence of water in the south in recent pre-historic times, so does the north present evidence of the former existence of much more water than it now contains. The prairies of North America, the plains of Europe, and a large part of Asia, were recently under the sea. The very extensive prevalence of the waters where now they are not, from the Arctic regions to the Great Sahara, is undeniable. Another distinguished geologist, Sir Roderick Impey Murchison, tells us that the main features of South Africa have been, as they are now, for countless ages anterior to the existence of the human race; and Mr. Darwin, one of the most exact explorers, examined both sides of the continent of South America, and found no extensive fossiliferous sediment of any age between the older tertiary and that of quite modern date.

Australia, although at present imperfectly known, differs still more widely from the northern hemisphere than any other region, and the general barrenness of the continent, as reported by travellers who have explored it from south to north, lead to the confirmation of the Rev. Julian Wood's opinion, that the geological aspect of Australia is similar to what Europe was immediately after the secondary period. Professor Sedgwick, who, in his Preface to Dr. Livingstone's Cambridge Lectures, traces the

difference between the two parts of the world further back, and describes it as being enormously great; in fact, in the absence of what are termed Mesozoic* deposits, shuts out the southern hemisphere from the monuments of past time which mark the middle period of the earth's history. We shall, however, show that the above opinion of earlier days must now give place to new discoveries. Professor M'Coy, of the Melbourne University, and Curator of the splendid Geological and Mining Museum of that city, has placed the question beyond doubt as to the Mesozoic division not being wanting in the geological series of Australia, by the discovery of abundant remains of cretaceous and oolitic fossils of that period; one of the fossils of the cretaceous era being a well-defined head, with eyes and teeth, ribs and paddle, of *Ichthyosaurus Australis* (M'Coy), with other Enalisauriæ, including those of the Pleiosaurus, &c. These were found at the head of the Flinders River, which empties itself into the Gulf of Carpentaria, North Australia.

The tertiary drift in Australia is also well defined as coming from the north, from which direction, southwards, its course is marked by boulder de-

* Mesozoic—Gr. *mesos*, middle; and *zoe*, life. The great division of stratified formations holding the middle forms of life, as differing from the Palœazoic (ancient) or Cainozoic (recent).

posits, which gradually decrease in size until past Sandhurst, Victoria, where they dwindle to pebbles. The gold fields are also capped with tertiary drift with intercalary trap strata. The mesozoic missing link in the geology of Australia having thus been discovered, the stratifications bearing the same general characteristics of uniformity with those of the northern hemisphere, and both being alike marked by deluge action, there must be a cause to produce this uniformity at parts of the earth so distant from each other.

That cause—namely, a vast inundation—it is not too much to assume, is rationally set forth in the theory propounded by Monsieur ALPHONSE JOSEPH ADHEMAR, in his work entitled "Révolutions de la Mer," who, arguing with a mathematical mind from certain well-known astronomical facts, and the influence of immutable laws relating to heat and gravity, demonstrates the cause of the cataclysms, one of which is known as "*The* Deluge," and predicates the recurrence, although at long distant periods, and in an opposite direction, of a similar change in the oceanic equilibrium. This theory of Adhemar, moreover, coincides with that which must be deduced from a comparison of the geology of the northern and southern hemispheres; for, assuming the preponderance, on the northern side of the equator, at some long past epoch, of the mass of

water which forms so large a portion of the earth's covering, a sudden polar disruption would produce a general deluge of that hemisphere, and its southerly course would explain the phenomena everywhere visible in the strata coming under the influence of its direction; otherwise, despite the suggestions of the advocates of "submergence" and of "glaciers," the whole of these phenomena must remain enveloped in mystery.

As a fitting prelude to the consideration of the conflicting theories referred to, let us briefly glance at the leading facts which our present geological knowledge has revealed.

Sir Roderick Murchison says he is irresistibly led to the conclusion that not long before, and possibly even after, the creation of the human species, there took place some of those great disruptions of the globe of which its surface presents such innumerable records. No such forces as the present riverine and atmospheric action will account for the complete denudation and clean sweeping which has taken place in innumerable plateaux, deep valleys, and gorges of hard rocks. From the nature of the contortions, fractures, and dislocations of the crust of the earth, *these must have been accompanied by diluvial and transporting waves* of incomparably greater power of translation, and consequently of denudation, than any force which man has ever

probably witnessed. We may reasonably infer that if an earthquake, and oscillation of the land of our period, can produce such wondrous effects by one wave, as lately occurred on the Peruvian coast, the effect of the infinitely grander waves of translation which must have often been put into play during the former gigantic oscillations of the earth's crust, must have well cleared the hills and valleys of all those broken materials which were left there by the disruptions of former times, whilst no ordinary action of atmospheric influence, and *no currents of the sea as they now act,* could have produced such remarkable results. Proofs of the *sudden* and violent change in the structure of the earth's surface are to be found, as Cuvier judged, in the frozen carcases of animals in the North; and, in the opinion of the same distinguished man, the evidence also exists of *a great deluge a few thousand years ago.* Such a change would sweep all sorts of *débris* of earth, and rocks, and animals, southward; transporting to a considerable distance large boulders—for things solid lose one-third, or more, of their weight when immersed in water; and the power of water to move bodies increases as the sixth power of the velocity of the current: double the velocity, and the power is increased 64 times; with four-fold velocity, it is increased 2,048 times; and so on with every augmentation of speed. There are very few people

who are not more or less acquainted with the immense power of air in rapid motion, as in gales, hurricanes, and whirlwinds; far greater, then, is the dynamic effect of the denser element, water, when its velocity is increased by some sudden cataclysm.

We may therefore assume that such a deluge as Cuvier and others find to have been among the comparatively recent phenomena of the globe, best explains the scattered boulders which have hitherto been regarded as the great proof of glacial action, and also most of the alluvial deposits which are strewn over all the earth; for such a rush of water would bear abundance of drift to the south, and scatter both fossil remains and the remains of all living creatures over all continents and islands. Shells from the north are found 1,300 feet high in Wales. Fragments of extinct animals of the pliocene* epoch are entombed, not only on the broad

* It may be well to explain to young readers that the geological division of the earth's stratified system forms three epochs—*i.e.*, PRIMARY, SECONDARY, and TERTIARY (Lat. *tertius*, third). This latter period has been subdivided into three other epochs. Thus, I. EOCENE (*eos*, the dawn; *kainos*, recent). II. MIOCENE (*meion*, less). III. PLIOCENE (*pleion*, more). There is a yet later period demonstrated—the Post-Tertiary, in which the RECENT and SUPERFICIAL accumulations occurred above the boulder drift which marks the PLIOCENE tertiary.

continents, but on the islands of the sea, far away from their probable home. Old shells have been washed out of their graves and mixed with newer shells, "rendering doubtful," as Sir C. Lyell admits, "the evidence of shells in strata." All these last cited facts, and with them the entire disappearance of the huge mammals of a recent age—which are puzzles, if not contradictions, to orthodox geologists—are fully accounted for by a nearly *universal deluge*. Although the most eminent geologists concur in representing the "stability of the water and the mobility of the earth," by an apparently paradoxical axiom, it is certain that, relatively to the land, the sea in the north of Europe formerly stood from twelve to fifteen hundred or more feet above its present level. One of two changes we must, therefore, admit. Either the water has subsided to that extent, and submerged some other portions of the globe, or the solid earth must have undergone changes of level so many and so great, that the bare conception of them awakens astonishment strongly tending to incredulity.

In connexion with the permanency or change of the level, it is natural to refer to Glen Roy and other remarkable mountain terraces in Norway, Belgium, France, and in the North of Scotland. One of these latter is between eleven and twelve

hundred feet in height, and runs for twenty miles, without, as far as is known, varying a single foot in elevation. Geologists are agreed that it was formed by water, standing at that height for a long time. The most obvious explanation amongst them seems to be that the mountain-top was formerly more bulky than now; and that the water, by its own action, eating into the side of the mountain, caused the *débris* of the upper part to fall; so lessening the bulk from the summit to the water-level, and increasing the bulk below the water-level, in which case it is evident that the materials rolled down would form at least one other terrace-like accumulation at, or towards, the bottom. The remarkable fact, however, we have chiefly to notice is the undisputed existence of a large body of water more than a thousand feet above the present sea-mark. How came it to be there? Geologists ascribe it to icebergs, and confess that they have no other cause to assign. We are asked to believe that huge barriers of ice blocked up the glens, one at least of these barriers towering a thousand feet above the valley on which it rested; that they were of sufficient strength and permanence to hold in for ages the vast lake that was forming the terraces, and keep at the same level; and yet the temperature was so moderate as to leave the surface fluid! Nor is this the only difficulty that besets us; for if

"stability of the waters, mobility of the land," is to be our creed, the recent marine remains found in the neighbourhood of Glen Roy, more than 600 feet above the sea, prove that there must have been, to a prodigious extent, both subsidence and upheaval of the land; whereas the absence of contortion in the strata of the mountains, and the perfectly equal and level of the terraces, demonstrate the entire absence of such changes.

Before we dismiss the subject of the elevated lakes of Glen Roy, we would offer a few suggestive remarks relative to them.

If, as it is believed, the water was retained at the altitude (just given) by the Glen-mouth being blocked up with icebergs, and whilst this was the case the waters of the lakes were fluid, and their wave-action hewed out the "terraces" from the mountain-side, there must have been times when the waves would beat on the ice-barriers also; and although water in a liquid state would of itself melt ice, yet, when lashed into fury by boreal gales, the waves would generate heat, and which, by their friction and percussive force, would melt, and probably wash down, the barrier in a single summer, at a time when its ice-gaoler was at its weakest period. We must again inquire how the water got there in the first instance, except at the deluge period? And if the waters were then imprisoned by ice, the lake

waters, unlike the ocean or rivers, being motionless from currents, would, each successive winter of that frigid period, be transformed into ice, like its barriers. However this may be, we do not think liquidity and frigidity could co-exist for any, even moderate, length of time.

In America, beyond the Rocky Mountains, by the Rivers Thomson and Fraser, there are terraces similar to those of Glen Roy, but on an immensely larger scale, running three hundred miles by the Fraser alone. They occur on the mountains of either side of the river, being of the same height on both. Their exact elevation has not been ascertained. Like terraces also exist in Norway, at present under investigation by Mr. Marshall Hall and Professor Kjerulf, of Christiana. It would be rash to affirm that both these and the Scotch terraces did not originate in local causes; but it is far from certain that they are not to be ascribed to common causes.

That in *portions* of our earth the solid ground has been, and is, subject to both depression and upheaval, admits of no dispute; some of its movements have been prodigiously great, and have produced many of the phenomena which the strata of the globe exhibit. But whether that cause be a tenable explanation of all the phenomena, and whether great changes in the sea level may not also have been among the mighty agencies in the pro-

duction of the existing state of the globe, we have to consider.

If we take our stand on a moderate eminence, and, *assuming the stability of the waters*, look around, we are driven to the conclusion that the scene spread at our feet has been "many times in succession the bottom of the sea, and a portion of the dry land." Observing the extensive districts in Europe and America, where the strata are not disarranged, but *in situ*, geologists would now probably hesitate to apply these words, as Dr. J. P. Smith did, to almost every spot on the earth's surface; but they still hold to the opinion that England, for example—or a very large portion of the island—was at least 1,700 feet lower than it is, and that different parts of it have risen and sunk, somewhat like dough in the process of kneading; and they explain, in like manner, the marine, fossil, fauna, and flora of most parts of the globe. An ordinary observer, accustomed to think of the rocks as somewhat solid, is startled by the facility with which the advocates of the "upheaval" theory speak of them as though they were almost viscid, and might be pressed downward or upward, and suffer but little damage from abrasion or torsion. Point to some place where, if the waters have been stable, the ground must repeatedly have gone too far down for sea-bathing, and as often come up

into mid-air, and you create no difficulty in the mind of the "upheaval devotee;" though to yourself it may seem all but certain that such changes, occurring repeatedly where the upheaval relates to small areas, must, by the crash and breakage, have converted the crust of the world into a chaos of rubble, notwithstanding the dependence placed on the elasticity of rocks.

The American Pampas is a district three times as large as the whole of France, and is a vast deposit of mud, in which are entombed mammiferous remains in wonderful abundance. One cause alone can explain its existence—namely, a deluge sufficiently vast to leave behind, as it surged and rolled to the mouth of what is now La Plata, that prodigious residuum of mud and animals which its mighty force had swept from the north. M. Alcide D'Orbigny, one of the explorers sent out by the French Government to South America, concludes the Pampas to be the effect of a prodigious deluge just before the human era. He says: "The clayey deposit of the Pampas is one of the most beautiful geological facts, and deserving of careful investigation. . . . I think the huge mammifers of the Pampas are not in their birth-place, and that they have been borne thither, not by flowing streams, but through a geological convulsion which destroyed them all at a stroke. . . . Imagine the complete

repose of nature followed by one of the great convulsions of the globe—for example, the upheaval of the Cordilleras; and the immediate result would be the destruction of all the living creatures of that part of the world, and the vast clayey deposit of the Pampas. . . . If it were not so, it would be hard to conceive of and explain two important facts—the sudden and simultaneous annihilation of the huge terrestrial animals which inhabited the American continents, and the immense accumulation of Pampean mud. The Pampean earth is the last deposit of great importance which preceded the existing epoch."

One more authority may be here appropriately cited, ere we come to the investigation of Adhemar's mathematical calculations relative to the periodicity of terrestrial deluges. It is that of Dr. Edmond Hitchcock, who says that "all of the northern parts of the American continent have been swept over by a powerful current from the north-west to the south-east. *The diluvial waters must have been oceanic.* What other agency could have here produced a current two thousand miles in width? There is no reason to suppose the inequalities of surface which now exist were essentially different at the epoch of diluvial action, for we find the boundaries uniformly obstructed in their path just as they would have been if the present mountains

had then existed. I am unable to see how glacial agency could have transported *detritus* in a southerly direction several hundred miles over nearly all the most elevated ridges of the American continent, and even have *driven it upwards* along slopes considerably inclined, as appears to have been done on the western side of New England."

In following the profound reflections of Mons. Adhemar, we are constrained to admit that it has been established beyond doubt that the immediate cause of the cataclysm which is known by the name of "Noah's Flood" was a disturbance of the equilibrium of the ocean—the inevitable consequence of a change of its centre of gravity. And what *has* happened, probably many times,* can be safely calculated to happen again, and from the same causes. The seas, *shallow* in comparison with the mass of the globe, are spread over the greater part of its surface, so as to render it (were it flat instead of spherical) like a shallow milk-pan all but filled with water. Tilt the pan ever so little, and the water rushes to one side, leaving the opposite side uncovered. Shift the centre of gravity of the terrestrial globe, and the oceans must obey the new

* A learned geologist and professor at the Military School at Brussels, M. de Hon, author of "Périodicité des Grands Déluges," counts no less than fourteen such deluges from the beginning of the tertiary period up to the present day.

point of attraction as surely as the tides obey the moon. As the deluge, which bears the name of Noah, was a disruption of the northern sea to the south pole, that which is predicted by Adhemar will be in the opposite direction. The immense period of time that will intervene—contemplated by the limited faculties of man—may be as accurately calculated as the distance or weight of any of the heavenly bodies. In about sixty-three centuries hence the ocean will take repossession of its former bed in the northern hemisphere. The South Pacific, South Atlantic, and Antarctic Oceans, will be suddenly poured across the equator and submerge the northern hemisphere; the high grounds, rising above the level of the Southern Ocean, will form the archipelago of a new Polynesia. Australia, by the GREAT BARRIER REEF being laid dry, will be joined to New Guinea, and thus acquire a new eastern sea-board 1,200 miles long, between which and the present Australian coast will be a wide valley, now the navigable channel for ships bound northwards, which would soon be covered with cocoa-nut, palms, and other beautiful flora of the southern hemisphere; whilst the greater part of England, Scotland, and Ireland, will become what they were before the last catastrophe (which acted in the opposite direction). Unknown continents will emerge from the ocean-abyss of the south. The Pacific

islands will become huge mountains, raising their summits to the clouds, soon to be covered with "eternal snow"—that is, eternal until the next oceanic revolution. As a matter of fact, *the mountains will not rise,* but the effect will be the same *by the retiring of the sea* from the southern half of the earth's surface, thus placing the continental hemisphere on the southern, instead of as at present on the northern side, of the equator.

During the interval between Noah's flood and that which preceded it the grand mass of ice surrounding the North Pole reached, at the epoch of its greatest cold, to the sixty-sixth degree of latitude, and the sites whereon now stand the principal cities of Europe were all under water.

What is now Ireland was then a group of four separate islands; England consisted of four islands likewise, divided from Scotland by a strait of the sea —the Firth of Forth.

A very slight alteration in the position of the earth's centre of gravity is quite sufficient to produce these vast conclusions—vast relatively to their effects on an animated nature—so nice is the equilibrium. For the depths of the ocean and the elevation of the highest mountain-tops are so trifling in comparison with the immense size of the globe, that Biot, as is well known, compared them to the irregularities on the skin of an orange.

M. Adhemar has calculated the comparative volume of a chain, or rather a considerable group, of mountains, and he finds that if we suppose the circumference of the globe to be represented by an ordinary dinner-plate, the abdomen of a common house-fly will represent the present group of all the Alps united.

The vast chain of the Andes, being the highest mountains in the world (the Himalayas excepted), appears enormous to an atom like man; but it is in reality only a slight wrinkle.

It is clear, then, that if anything occurs to shift the centre of gravity only a moderate degree, it will make all the difference on the outspread waters between stable and unstable equilibrium.

A glance at a map of the world informs us that the mass of water is very unequally portioned out between the northern and southern halves of the globe. In the northern hemisphere the land bears to the sea the proportion of 415 to 1,000; in the southern, of 129 to 1,000. Here follow the same parallel of latitude — forty degrees, for instance; above and below the equator, and the northern hemisphere, it passes close to Madrid, Constantinople, Pekin, and Philadelphia, and is almost entirely continental; whilst in the southern hemisphere it is almost entirely maritime; as except Patagonia and a few islands, there is nothing between it and

the Antarctic circle but ice and water. The fact is too evident to require further comment. The Antarctic Seas, four times vaster than those of the North, are also deeper. At the points nearest to the North Pole which have been reached, the soundings have never given more than three hundred fathoms; whilst in the opposite hemisphere it has marked four thousand, and more, without touching bottom. Captain Ross found four thousand. M. d'Andrial cites a case in which a line charged with 400 lbs. ran out to about 10,000 yards, and only stopped for want of rope. Captain Durham sounded in the South Atlantic, between Rio de Janeiro and the Cape of Good Hope, and obtained 7,706 fathoms, nearly equal to 7·7 geographical miles. In this abyss, Everest, the highest known mountain, and the loftiest of the Himalayan peaks (29,002 feet) would be immersed in a depth of 17,234 feet beneath the level of the sea. And there is reason to conclude, from the investigations of the late Dr. Whewell on COTIDAL LINES, that a depth of nine miles was obtained in the SOUTH ATLANTIC.

If, in comparing the Northern and Southern Oceans, the depth is taken into consideration as well as their superficial areas, it will result that the mass of waters constituting the SOUTHERN OCEAN is more than four times as great as that constituting the northern. Upon looking at the best maps of the

polar regions, we find that at the north, with two or three exceptions, the ice is far from extending down to the 75th degree of latitude, whilst on the south side of the globe the ice forms a zone or circle with a radius of more than twenty degrees.

The only open point in this zone is where mighty Erebus—that immense volcano dicovered by Ross, whose flames dart to the height of 2,000 feet—explains the existence of this unfrozen patch of sea.

The Arctic (or northern) regions are capped by a circle of ice, having a surface area of 294 square leagues; whilst the Antarctic (or southern) regions consist of a continent of ice, having a surface of 755,000 square leagues. And yet a single volcano keeps open that never-frozen gulf in the midst of those immense regions of Antarctic ice, some of the escaped berg-fragments from which have been found to measure many miles in diameter, with their peaks 1,000 feet high; and as peaked icebergs float with seven-eighths of their altitude immersed, their total height would be 8,000 feet!

According to late evidence of several South Sea whaling captains, drift ice has been greatly on the increase in the South Pacific during the last ten years; thus showing that it is loosening its hold at the pole. An equally significant fact is reported that within the memory of man the sea has risen two feet on the coast of Greenland. These facts,

although of infinitesimally small moment in the march of Time, yet still bear their silent testimony in favour of Adhemar's "Révolutions de la Mer."

It has been ascertained, by a series of carefully-conducted scientific observations, that the northern hemisphere is gradually cooling; that the Arctic ice is steadily encroaching on the yet unfrozen portions of Europe, Asia, and America; that the summers of France and England are not so hot as they were in olden time.* While the northern hemisphere is thus cooling, the southern is accumulating heat; and while the ice is gaining ground in the north, the frozen regions are fast losing their icy grip in the south. Moreover, it is now established beyond doubt that the whole south coast-line of Australia is progressively in process of being elevated above the surface of the sea. Such re-arrangement of land and ocean surfaces must produce, as well as mark, change of the earth's centre of gravity—an agency brought already into play by accumulation, in disproportionate quantities, of dense and ponderous matter, during centuries, within the polar circle, and quite adequate of itself to account for the results of gravitation of the unstable element, in conformity with the requirements of such change of centre. The alteration effected by

* The cycles of heat we may occasionally experience will not invalidate these views on progressive cold.

such agency in apparent elevation of coast-lines and ultimate submergence of some areas, while others rise to the altitude of perpetual snow, might, throughout ages, be slowly and scarce perceptibly progressive. But, as evidenced in past geological eras, sudden devastating revolutions might occur were depressed areas, such as the central Asiatic basin —opened by igneous agencies to the inroad of the ocean—or any other physical catastrophe, to ensue, involving loss of the finely-adjusted equilibrium by which our globe is sustained in her present position upon the plane of her orbit. The same first physical cause, inducing change of centre, is continuously in operation. Why, then, must we remain blind to the inevitable conclusion forced upon our views that recurrences of the great cataclysms revealed by geology are impending upon our earth? Come when they may, they are the inevitable consequences to be anticipated from operations, now in continuous progression, of the well-analysed laws of meteorology and terrestrial gravitation.

CYCLICAL DELUGES.

PART II.

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"EARTH TREMBLES, AND AIR IS AGHAST."

HAVING shown that the oceanic cataclysm which bears the name of "Noah's Flood," was caused by the sudden departure of the northern seas, which rushed towards the Antarctic pole, let us now apply to the southern hemisphere Mons. Adhemar's calculations in reference to the next inevitable change which is destined to deluge one-half the earth, originating in a contrary direction to the last universal flood, and which must take place at the remote period of about sixty-three centuries from our era, if not precipitated—as it may be—by any imminent igneous agency, such as that referred to in the closing paragraph of the preceding section. In this investigation four propositions have to be borne in mind, namely—

I. The earth describes, in the course of its annual revolution round the sun, a nearly circular ellipse, one of whose foci—of which every ellipse has two—is occupied by the sun.

II. The same season does not reign at the same

time all over the globe. There is, on the contrary, a complete opposition in this respect between the northern and southern halves of the world; for winter in the south answers (nearly) to the summer of the north hemisphere, and the south spring to its autumn.

III. The seasons are not of equal length in either hemisphere, which is the consequence of the elliptic form of the earth's orbit.

The southern autumn and winter — which correponds to the spring and summer of the north—takes place while the earth is describing the smaller arc of its orbit—that is, the one nearest the sun, and the centre of which is termed the perihelion.

Now, not only has the earth a shorter distance to travel during the southern spring and summer than during the other two seasons, but being at that time nearer the sun, that luminary then exerts a greater power of attraction, whereby the earth's motion becomes accelerated. It is thus that the austral autumn and winter last together 186 days, whilst the spring and summer are only 179; that is, the seasons of autumn and winter are, in the southern hemisphere, seven days longer than those of spring and summer. Precisely the reverse of this takes place in the northern hemisphere, where the spring and summer are correspondingly longer than the autumn and winter.

IV. There was a time when the South enjoyed the longer spring and summer, for the privilege falls to the lot of each hemisphere by turns; therefore a like time will again come round.

These four propositions form together the basis of Adhemar's theory, which, being borne in mind, will render what follows so simple that it may be clearly understood by all.

The four seasons are, in both hemispheres, distinguished by the same terms—namely, two equinoxes and two solstices; that which in the North is called the vernal equinox, as marking the beginning of spring in that hemisphere, is in the South the commencement of autumn. In like manner at the Southern summer solstice—that is, the time when the earth is at the nearest point to the sun—it is the beginning of winter in the North; and at the South winter solstice—when the earth is at the greatest distance from the sun—it is the commencement of summer, north of the equator.

During the entire course of one revolution of the earth round the sun—that is, a single year—there is no sensible change in the inclination of the earth's axis, but in the lapse of ages that inclination has perceptibly changed. The earth, being an oblong spheroid, is slightly swollen, or bulges out, at the equator, and the sun's attraction, acting on this swelling, has the effect of changing the inclination

of the axis. It is analogous to the rolling of a top whilst its toe remains spinning on exactly the same piece of ground. The top's axis, more or less inclined towards the ground, describes a conical surface round the line perpendicular to the plane on which the top is spinning. The solar attraction, combined with the diurnal movement, impress a similar movement on the globe. This change of direction has the effect of altering the date of equinoxes already referred to. Now, in the year B.C. 1,248 the North Pole attained its maximum summer duration of heat. Since then the ice has continued to increase from that date, and will so continue until it again covers nearly all Europe and North America (of which we have marine and glacial witnesses), and when its maximum is reached the great deluge cataclysm will occur; that is to say, for the last 3,118 years it has begun to decrease, or become cooler, and this will go on to the year 7,382 of our era before it attains its maximum winter duration of cold, at which period, according to Adhemar, the next deluge from South to North is to take place. On the other hand, the South Pole had, in the year B.C. 1,248, attained its maximum duration of cold, and has been getting warmer during the past 3,118 years, and it will attain its maximum duration of heat in 7,382 of our era.

In order to make this clear to our non-scientific

readers, we will in part recapitulate this remarkable phenomenon in its purely astronomical aspect.

The first day of winter in the northern hemisphere, consequently the commencement of summer in the South, occurred when the earth was passing the perihelion, or nearest point to the sun in his annual orbit; and the first day of the northern summer, therefore the beginning of winter in the South, fell upon the day when the earth was passing the aphelion, or most distant part from the sun in his elliptic orbit. In this way, from the year B.C. 1,248 to the present, which embraces a period of 3,118 years, the Austral autumnal equinox has drawn nearer to the earth's solar perihelion by more than ten degrees; consequently the southern summer solstice, which was then at the perihelion, retreats from it; the southern vernal equinox advances towards the winter solstice, and the winter solstice towards the autumnal equinox; for all the points of the orbit follow the same movement. As this movement goes on, the southern autumnal equinox will at last take place at the time of the earth's passing the perihelion; it will then be beyond it, and will, in the course of time, take the place of the vernal equinox, which will have taken the place of the autumnal equinox, exactly as the two solstices will also have mutually changed their positions. That is to say, in the course of time the order of the

seasons will be reversed, in respect to the four principal points of the earth's orbit; the southern spring and summer will take place at the aphelion, or greater distance from the sun, and the autumn and winter at the perihelion, or nearest point to the sun in the earth's annual orbit. The contrary will be the case for the northern hemisphere, where the autumn and winter will then be seven days longer than in the southern hemispheres, *and every year the sun will shine seven days longer on the South Pole than on the North Pole.* This forms the key to the cause of alternate deluges.

It should be observed that the change of the equinoctial points takes place in a direction opposite to that of the earth's motion in her orbit, whence the name of the "Precession of the Equinoxes" given to this grand phenomenon, which has long been known to astronomers,* although M. Adhemar was the first to build upon it his theory of the periodicity of the great deluges. The rate of the movement of precession is so slow that its entire revolution round the earth's orbit requires 25,868 years; but, in fact, it is practically shortened by another phenomenon, which modifies the duration of this long period. In consequence of the attractions exercised by the planets upon our globe,

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* First discovered by Hipparchus, 200 years B.C.

the major axis of the earth's orbit changes its place; it moves in the place of the orbit, and in the same direction as the earth itself; and consequently in a direction contrary to the equinoctial revolution. Thus—to have a clear idea of the case—whilst the Austral autumnal equinox goes backward towards the perihelion, the perihelion, in consequence of the gradual motion of the earth's axis, comes forward to meet that equinox. The effect of the displacement of the line of axis is, therefore, a shortening of the duration of the revolution of the equinoxes, abbreviating it, in round numbers, to 21,000 years; consequently, every 10,500 years the order of the seasons in the two hemispheres is reversed in respect to the equinoctial and solsticial points—that is, the dates when spring, summer, autumn, and winter begin. It must be observed that the annual orbit of the earth being an ellipse, there are two main points in which the centre of gravity alternately resides. As each complete change, or alternate great summer and great winter, comprises in round numbers 21,000 years, a division of the elliptic into three portions gives 7,000 years for the initiation of each alternate change. In about half of another 7,000 years, modified by various causes alluded to in the text, and making together the half of the total 21,000, the cataclysm of a change of the oceans from South

to North, and *vice versâ*, have gone on, and will go on until interrupted by a Power superior to the Material Universe. Each of the earth's poles is loaded with vast serried mountains of ice, but of unequal dimensions and elevations; as the Antarctic mass is the more considerable, the centre of gravity of the whole mass of the globe is drawn into the southern hemisphere, along the radius which terminates at the South Pole, carrying with it the waters spread over the earth, and laying bare a portion of the continents of the northern hemisphere. As the displacement of the centre of gravity is slow, the displacement of the seas is also slow. They gradually retreat from one hemisphere, and as gradually take possession of the other; and in this gradual movement there is nothing which entitles it to the name of a catastrophe or a grand convulsion of nature. But let us note the consequences, and inquire what will happen ten thousand five hundred years after the last deluge, when the seas will have been amassed in the southern hemisphere. Little by little the northern icy mass increases, the southern diminishes. During a long period the deep waters nearest to the centre of attraction transport themselves from the South to the North. The northern seas insensibly rise, the southern seas as gradually subside. On the northern side of the equator, lowlands, shores,

cultivated fields, and forests, are gradually submerged; on the southern side of the line, the land gains upon the sea, which retires. But all this takes place on a limited scale, and small changes require long periods of time. At last the momentous hour arrives when this regular and progressive movement gives place to a sudden and vast perturbation of equilibrium—namely, when the Boreal (or northern) glacier, having reached its maximum of extension, and the Austral (or southern) glacier its minimum, this latter has become sufficiently loosened from the grip of its long icy prison by the accumulated heat of the sun, that it is broken up; and the instant of its breaking up sounds the knell of a universal cataclysm. As soon as the fragments of the great southern ice mountains are separated into floating icebergs, drifting at the mercy of the waves, the attraction of the northern glacial mass becomes preponderant, and the centre of gravity of the globe, suddenly traversing the plane of the equator, passes into the northern hemisphere, dragging after it, in a mighty torrent, almost the total mass of the waters, whose velocity creates a hurricane, accompanied probably by lightning, thunder, terrific earthquakes and volcanoes vomiting forth flames and stones thousands of feet high, such as the world only can experience during similar dread catastrophes. In ten thousand

five hundred years afterwards another deluge occurs, in an opposite direction; and so on, during the whole enormous period that the precession of the equinoxes has been, and shall be, an astronomical fact.

We do not exactly know the depth of the seas around the South Pole, nor the hidden height of the Antarctic ice above the level of the sea, nor its density. To supply this deficiency, M. Adhemar reduces the question to a problem of Statics. The depth of the ocean increases regularly from the North to the South Pole. The solid sphere which forms the globe, and the liquid sphere which is formed by the seas, are not parallel at their surfaces, and the centre of one is about half a league distant from the centre of the other. The point is to demonstrate that the excentricity of these two spheres is caused by the attraction of the ice accumulated at the South Pole.

With this view he inquires into the conditions of equilibrium between the earth, the sea, and the two polar glaciers. He arrives at the result that the immense mass of the seas is held in equilibrium by a force 382 leagues from its natural centre. In order that the force of attraction possessed by the Antarctic glacier can produce this astounding result, it must have a height of twenty leagues. This seems a prodigious altitude. But by the help of

the eclipses in which the earth casts her shadow on the moon, something may be ascertained respecting the projection of the polar ice. Kepler relates that the eclipse of the moon of the 26th September, 1624, which was total, and almost central, surprised him greatly, "for not only," he says, "the duration of total darkness was short, but the remainder of the duration of the eclipse, before and after the total obscurity, was still short, as if the earth were elliptical or lemon-shaped, and had a shorter diameter across the equator than from pole to pole."

It should, however, be observed that this assertion of Kepler's, arrived at no doubt by the inferior instruments at his disposal at that early period, is not shared by modern astronomers, whose observations, since made on eclipses, have indicated the oblately spheroidal shape of the earth. The polar protuberance, to be apparent in an eclipse, must have been enormously greater than has yet been conceived possible; and geoditic measures point to the same conclusion.

Nevertheless, Adhemar may have much truth on his side, although not susceptible of positive demonstration; for when we consider the ages which have passed over the unknown regions of the south polar basin since the commencement of her long cumulative winter 13,618 years past, its lofty ice-peaks must dwarf into nothingness the highest summits

of the Himalayas; every snow particle which shall have struck their ever glacial sides has become a cemented portion of the mass, until the ice mountain shall be launched from its long imprisonment and set floating, by the dread cataclysm of a deluge, towards the equator, there to release the snow flakes, we have taken as an example of the means afforded by snow falls—to say nothing of frigid marine accumulations—for the south polar ice-mountains to become of an altitude which man can hardly conceive, as compared with the icebergs he has hitherto witnessed, notwithstanding we have elsewhere described one of 8,000 feet total altitude.

A comparison of the deluge theory of Adhemar with some well-known geological phenomena will afford remarkable confirmation of its apparent truth. A great catastrophe has devastated the northern surface of the globe, leaving in that hemisphere, to testify to its power, that extraordinary phenomenon which has been named by Moses and others, "Noah's Flood;" by others, "The Diluvium of the North." Innumerable erratic blocks, of all dimensions, some of them containing 50,000 feet of granite—which would be equal to the weight of 4,166 tons—have been torn from regions near the North Pole, and transported along every meridian down to the fifty-second parallel, and raised to altitudes exceeding 500 yards. They are scattered

over the plains and tablelands of the Old and New Worlds. In all cases they have been arrested by the heights, and they have been stranded on the northern slopes of mountains, thus showing they were journeying southwards, whilst open grounds and lowlands have admitted their passage. Their abundance and their volume are in proportion to the latitude, and the nearer they are to the pole the more considerable is their number and the greater their dimensions. On beholding the sharpness of their edges, the freshness of their fractures, and their perfect preservation, one is tempted to say that some colossal hand, clutching them at their point of departure, had deposited them, unaltered, at their destination. The whole of that part of America situated between Newfoundland and the Upper Mississippi is thickly strewn with these erratic boulders. They all lie on the south or south-east side of the mountains from whence they came. Some, torn from Canada, have been carried five hundred miles away, as far as Ohio, in the thirty-eighth degree of latitude; others, stripped from Labrador, have been cast on the southern coast of the Gulf of St. Lawrence; and sandstone, plucked from Prince Edward's Island, now lies in Nova Scotia. Innumerable fragments, twenty or thirty feet thick, have made shipwreck in fifty degrees, at an altitude of a hundred yards. New

England can show blocks of considerable size that are situated four hundred yards higher than the rocks from which they came. In Europe enormous masses, detached from the mountains of Sweden and Finland, are disposed in prodigious numbers over Germany, Poland, and Russia—one of these latter forms the pedestal of Peter the Great. On the south side of Lake Onega blocks are seen which form part of the opposite coast. Erratic boulders are found as far to the south as the forest of Fontainbleu, where a few have been re-transported by human agency to decorate the Bois de Boulogne, and others, for Prussian promenades. Immense tracks of transported material, consisting of sand, gravel, shingle, clay, mud, and all sorts of sweepings off the face of the earth, and encrusted with erratic boulders, cover vast regions to a depth which attains as much as three hundred yards, forming sometimes grand horizontal plains; sometimes lines of hills, stretching along from north to south; the steppes of Russia, the sands of Gascony, and the stratum of sand and clay, more than two hundred yards thick, which covers Holland, belong to this deposit. In England there are examples of diluvium on a tolerably extensive scale. A celebrated living professor said, truly, that Norfolk is nothing but a heap of rubbish, which has been superimposed on forests, the trunks and

roots of which are now visible, owing to the denuding action of the North Sea. The subsoil of Cambridge is a fragmentary bone-heap of pachyderm mammals. Mysterious marks, stripes, furrows, and flutings, sometimes two feet deep, have been scooped out by an irresistible chisel in the granite flanks of mountains that have been ground down, smoothed, and polished by the agency of an anonymous workman. The constant direction of these marks is north and south. The phenomenon is especially remarkable in Finland, in Sweden, in Norway, and the British Islands. Such is the collection of facts which constitute the last diluvium.

Geologists are all agreed as to the frigid area of the northern hemisphere at a given period of the earth's history; how, then, came the temperature of that region to be changed, as we now find it, unless by planetary forces acting on our globe by known astronomical laws, the truth of which are also acknowledged by astronomers? In favour of the last deluge we have material records of its action in the footprints of its journey, during which were cast off erratic blocks and boulders as mute mementoes of the fact. The other side? The dissentients to the deluge theory? They believe *something* took place, their opinions on which are full of contradictory geological puzzles, which are unsatisfactory to reason and against the *material facts* contained in this book.

The explanations hitherto given of these facts have only contained a portion of the truth. That they are the effect of Agassiz's grand polar glacier is scarcely admissible, because, although glaciers do slide down valleys in the Alps, this glacier would not have been stirred on a vast horizontal plain! What was wanted, was a theory which should explain and account for the whole of the phenomena observed. A step towards it was recently made. In a report by M. Eli de Beaumont on an able memoir from M. Durocher, it is proved that the force which produced the diluvium proceeded from the regions in the neighbourhood of the North Pole; that an immense mass of waters, accompanied by icebergs, rushing from north to south, inundated the northern countries of the globe, from Greenland to the Ural Mountains, stripping the highlands, polishing and channelling the rocks by means of lithic gravers, set in the sides of icebergs, which it hurried along with it; rolling in its waves the immense alluviums, the soil of which constitute grand valleys, and, lastly, transporting enormous blocks of stone by the aid of icebergs. The Baltic annually offers a similar spectacle, on a mimic scale, when the ice breaks up in spring; masses of granite, embedded in the ice, are carried by the currents to great distances. Dr. Scoresby, during his voyage to Greenland, saw ice-

bergs a hundred feet high, so laden with stones and rocks that the ice itself was almost invisible.

M. Adhemar thus explains the theoretical action of that force which ravaged the southern hemisphere, showing why it set out from the Boreal polar regions, and proceeded in a southerly direction. During ten thousand five hundred years, the excess of the hours of night over the sum of the hours of day, an immense cupola of ice was formed over and around the North Pole. It reached lower than the seventieth degree of latitude, and gave to the Arctic rocks their peculiar aspect. The attraction of this grand glacier had drawn to that side of the equator almost the totality of the seas, whose level stood much higher than it now does. The northern continents were for the most part under water, whilst those of the southern hemisphere were high and dry, and perhaps inhabited by some variety of the human race which was destroyed at the last deluge. Seven thousand years before that deluge the northern ice region had attained its greatest development. From that date the sum of night hours in the northern hemisphere diminishing, and the sum of day hours increasing, the North became warmer, the extent of the great glacier was gradually decreased; while an opposite effect was taking place at the South Pole. After the lapse of seven thousand years, the continued action of the

sun's heat having sufficiently softened the North Polar ice, the grand break-up occurred; the northern seas, and the fragments of the ice mountains, obeying the sudden displacement of the centre of gravity, rushed in a body towards the South. Torn from his bed, Old Ocean carried with him his mud, with which he formed the extensive lands of transport which constitute the diluvium. Gigantic streams of water, mingled with earth, sand, and pebbles, formed the alluviums of the great valleys; finally, erratic boulders, sustained by the ice, were raised by the piling up of the Arctic waters to the altitudes they now occupy, and remained shelved on the sides of mountains whose tops they were unable to scale. Thus was produced the last deluge, about four thousand two hundred years ago, which is commonly known as "The Deluge." The next is to occur six thousand and nearly three hundred centuries from our era; but many physical influences may accelerate or retard it.

A traveller journeying from the North Pole to the South, along any one given meridian, could not fail to note that, in proportion as he gets further and further from his starting-place, erratic boulders become less and less numerous; at about the thirty-fifth degree of latitude they become scarce, and from that point to the Line (or equator) they are almost completely wanting. But the southern hemi-

sphere, like that of the North, has in long past ages also had its diluvium; therefore, the phenomenon is common to both poles.

In the "New Zealand Institute of 1868," Vol. I., we have the following (by the Hon. J. Coutts Crawford, F.G.S.), which in its general geological features—having reference to the periodicity of deluges—would equally apply to the northern hemisphere. In the part relating to the North Island it is stated: "We find a flooring of Paleozoic rocks, generally, perhaps invariably, inclined at high angles, and on this flooring we find the brown coal, with accompanying shales, deposited unconformably. At the period of deposition of the coal we must have had dry land for the growth of the coal plants. After the deposition of the coal the Island must have undergone depression, and as it sank the various tertiaries must have deposited above the coal.* Not yet perhaps did the volcanic eruptions commence, but as the country gradually sank and reached its point of greatest depression, the crust of the earth was broken and streams of basalt flowed over the surface; the depression probably reaching a depth of 1,800 or 2,000 feet." Further on we find, "Nature having completed her work so

* Here must be an error, as the brown coal of both New Zealand and Tasmania is tertiary—not supra-tertiary—as Mr. Crawford would lead us to believe.

far, the Island commenced to rise again, slowly and steadily, by slightly disarranging the tertiary rocks on either side of the Island, the volcanic eruptions doubtless still continuing. The Island appears to have rested in its rise at various points—at from 1,000 to 1,200 feet;* at 400, 150 to 200 feet; at 15, and at 9 and 4 feet." We have here only to assume that the Island remained *in statu quo* (which no doubt was the case), then raise the ocean in its gradual change towards a reaction, and we have the complete and true progress towards the last deluge in the southern hemisphere. Australia, New Zealand, and Tasmania have their mute witnesses of the post-pliocene deluge in all the drift-strata proper to that formation which exists in the northern hemisphere.

The cave-dwelling man is not wanting to complete the analogy in the South, even the same as we find him dwelling at that period in the northern hemisphere. The aborigines of New Zealand have left memorials of the fact in their rude, yet flowing, hieroglyphics, etched on the walls of their caves, and in the bones of the Moa on their floors, together with chist (silicious limestone) implements of the

* Here again we find repeated the ocean levels as given in the case of the parallel roads of Glen Roy, and the raised beaches of the valleys of the Somme and the Meuse, at the antipodal part of the globe.

chase and of war, as their fellow-men had them of flint at the North antipodes.

It would appear that the wingless bird Moa formed the highest type of life before cannibalism co-existed with the Moa; and the remarkable absence of mammals throughout the entire, now fruitful, island groups which dot the southern hemisphere* (in all of which cannibalism prevailed, and does so yet in many), points with truthful significance to the high probability of successive deluges having swept those islands bare of all animal life, except perhaps a few scattered tribes of the human race, whose endowment with reason saved them, and who subsequently (having consumed the Moa, which soon became extinct) preyed on each other for subsistence, until the alleviating benefit of cultivation dawned on them, and softened the inhuman practice which stern necessity had imposed to enable them to retain life.

M. Adhemar demonstrates that ten thousand five hundred years before the deluge which bears the name of "Noah's Flood" there must have been a previous deluge, produced by the disruption of the southern ice region.

The Austral diluvium, then, is the witness of the last but one general cataclysm; it occurred when

* New Zealand, for instance, only possesses one native rat as her mammal representative.

the mass of the seas (which were then, as now, in the southern hemisphere), and the ruins of the great Antarctic glacial mass, were rapidly borne towards the North; and the erratic blocks (whose train extends from Cape Horn to the forty-first degree, where they were arrested by the mountains of Brazil and Bolivia) date, like the clay of the Pampas, referred to in the previous section, from fourteen thousand seven hundred years ago.

From this same cataclysm dates another phenomenon, one of the most remarkable in the history of the world. Every one has heard of the extraordinary object found in the last century on the banks of the Lena, North Siberia. The ice, in melting, exposed the body of a Mastodon in such perfect preservation that dogs ate its flesh, until Dr. Clarke conveyed the skeleton to St. Petersburg, in the museum of which city it now stands. Buffon mentions six elephants preserved in the ice, near the Ohio, in America. Sarytschew discovered another on the banks of the Alascia, a large river which empties itself into the Icy Sea. In short, there is scarcely a canton in Siberia which does not contain the bones of elephants. The islands on the Icy Sea furnish enormous quantities, which is put forward as a proof that this drear region was at one period possessed of a genial climate and suitable flora to

sustain these animals, whose fossil tusks have been, for the last five centuries, dug up, and bartered to the Chinese, and later with Europe, to the extent of 80,000 lbs. weight annually. As many as ten tusks have been found lying together in one spot, weighing from 150 lbs. to 300 lbs. each; and, notwithstanding the vast quantity which has been yearly removed, these quarries of fossil ivory do not in the least diminish. In many places, near the mouths of great rivers flowing into the Arctic Ocean, the bones and tusks of these drowned mammals of other lands lie scattered about like the Golgotha of an Indian city.

If, as geologists assert, coal is derived from vegetable matter grown *in situ* and then submerged, how are we to account for the Arctic regions being so abundantly provided with coal that it is found cropping out from the sides of the sandstone cliffs, and water-worn nodules of that mineral cumbering the beaches over large areas? Melville Island is one great coal-field, like Newfoundland and Prince Edward's Island, in the Gulf of St. Lawrence. Thus, while these inhospitable shores are seamed with coal, the genial climate and former forest lands of Essex, Kent, Sussex, Middlesex, Hants, Bucks, Oxfordshire, Suffolk, Norfolk, &c., have not a trace of mineral fuel. These cases furnish contradictions so gross that one is lost in

wonder that such a theory should be retained for a moment by any modern geologist, as here we have deductive proof that the above districts, having been cut off from sharing deluge Arctic timber-drift (on account of the Straits of Dover being then closed), are without bituminous fuel. On the other hand, the Arctic region, with its prolific mines of coal and fossil ivory, has been, from one deluge epoch to another, supplied by the rifted forests of sunny lands (and superimposed, in many cases, on the swamp vegetation of the period), from which were swept at the same time the tough-hided pachyderms whose bones are now being exhumed from the soil into which they sank when their bloated carcases had emitted the air which floated them on the roaring waters of the deluge, until they sank to rest at the polar circle—the goal of their dread ocean voyage.

How else is the presence of these great pachyderms in such a rigorous climate to be explained? Cuvier supposes a sudden cooling of the countries which they inhabited—an arbitrary supposition, which throws no light upon the subject. The same may be also said of the theory which supposes those icy regions to have once possessed a temperate climate, because of the discovery of animal remains, together with fragmentary specimens of fossil vegetation and of coral fragments, proper to a warm

climate. But we find the true elucidation of the mystery when we name the transporting waves of a deluge as the carrying agent. Although Adhemar's theory shows the elephants fleeing, before the last deluge but one, as far as the sixtieth parallel, which then formed the limit of the northern glacier, and there, falling exhausted by hunger, fatigue, and cold, they were soon covered by masses of snow, afterwards transformed to masses of ice, which have preserved them to the present day,—it may be doubted whether these were not exceptional cases.

Thus, starting from a grand law of the system of the world, the precession of the equinoxes, we arrive at the conclusion that grand deluges are periodical, and alternately occur from south to north, and from north to south; and we find, on inspection, that the earth has actually been ravaged by a succession of general cataclysms, separated from each other by long intervals of time; and that of the last two deluges, one—the most ancient —originated in the breaking-up of the Antarctic ice, and that the most recent was let loose from the frozen Arctic region of that pole. Not only has the sea its minor regular oscillations every six hours, alternately flooding and leaving bare narrow but far-spreading strips of shore, gradually undermining islands and continents, and producing important changes on the surface of our planet, but the ocean

has also its grand secular tides, which have punctually recurred every 10,500 years. When it is high water over one whole hemisphere, and low water throughout another, accompanied by such awful devastation by sea and land, such terrific convulsions in the sky overhead—for the equilibrium of the atmosphere cannot fail to be displaced at the same time with that of the seas—both would therefore rush wildly in one direction, accelerating each other's velocity and force; so that if human eye could witness that dread day, no human tongue could adequately describe it.

It is thus that we arrive at the conclusion that the next deluge will be produced by the breaking-up of the Antarctic glacier. The southern waters will rush down upon the northern hemisphere, which will be once more submerged; whilst in the south, as already stated, unknown continents will appear. Vegetable aud animal life on the north of the equator will, in a great measure, be destroyed; and the same must happen to the human race in that hemisphere, except perhaps a few tribes or families, who, escaping to the highest tablelands and mountain ranges of the earth, may survive, only to fall back, almost immediately, into a state of torpid barbarism, which shows no gleam of hope in its utter desolation.

CYCLICAL DELUGES.

PART III.

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"SCIENCE, BY SOLVING CREATION'S MIRACLES, ROBS EVEN JUPITER OF HIS THUNDERBOLT."

ASTRONOMERS have made us acquainted with the wonders of distant space; opticians have brought before our eyes the scarcely less astonishing facts of atomic life; electricians have enabled us to speak across oceans of almost fathomless depths, spanning distances of 4,000 miles; and geologists have discovered, not by happy guesses, but by hard toil, a new calendar of duration, incomplete at present, yet so sure in its general principles, and so vast in its sweep, that, to human apprehension, the gulf between time and past eternity is partly bridged over, and the spirit of man brought into nearer fellowship with Him to whom "a thousand years are as one day." By the exploration of the dateless, yet measured, past, they have shown us the orderly building up of the strong foundations of the earth on which men now live and cities rest; they have deciphered the Rosetta-stone book of Nature's past history; unravelled the secrets of her mineral and fossilized

hieroglyphics of the rocks; they have peopled the ancient world with creatures heretofore unknown; classified races and genera, tracing the progress from invertebrate to vertebrate, and from reptiles to mammals. Having accomplished these wondrous labours of research in the very dawn of their philosophic work-day, what may we not expect in the future, when, aided by the records of the past and present genius of our geologists, new labourers shall enter the fruitful field, guided by the illuminated garnered work of those gone by?

In this section of our subject we propose to survey the operations of alternate deluges, according to M. Adhemar's theory, in those various geological animal and vegetable changes that mark the present condition of the two hemispheres of our globe.

The strata of large areas in Australia, their mixed diluvial character of clays, sand, gravel, breccia, boulders, vegetable, earth, &c., with intercalary cappings of trap-rock, occurring, as they do, at about the same height above the level of the sea as the parallel roads of Glen Roy already referred to, or the raised beaches of the valleys of the Somme and the Meuse, in the northern hemisphere, all point to the agency of deluge action. The gold-miners of Australia, in sinking their deep lode shafts, have laid bare the channels of old world rivers, nearly five hundred feet beneath the present

surface, with prostrate trees, upwards of eighty feet long, lying along the bed, the wood partly charred by the heat of the molten trap-rock which covered the diluvial strata beneath, choked back its waters, and thus buried the river-bed countless ages ago, until revealed to our gaze through the agency of men who came from the antipodes to open this page in the geological history of the country of their adoption. Equally instructive are the inland depths of some of the southern rivers, whereon the largest ship ever built could float alongside their grassy banks; and yet it is remarkable that there is not one river in Australia which is free from obstructions at or near its embouchure. Its buried flora is nearly identical — particularly the encalyptic and acacia—with that of the earlier stages of the tertiary system of the old world; the fauna is of the marsupial species, traces of which have been found in the Wealden and Oolitic formations in England—a genus now almost wholly confined to Australia, and one or two islands of the neighbouring archipelago. There are, it is true, three chief localities in Europe—Purbeck, Stonesfield, and Stuttgardt—where these, the most ancient mammalia, have been found; and if these had all belonged to formations of the same age, we might, Sir C. Lyell thinks, have well imagined so limited an area to have been peopled exclusively with pouched quadrupeds, just as Aus-

tralia now is; while other parts of the globe were inhabited by placentals; for Australia now supports 160 species of marsupials, while the rest of the continents and islands are tenanted by about 1,700 species of mammalia, of which only 46 are marsupial —viz., the opossums of North and South America. But the great difference in age of the strata in each of these three localities seems to indicate the predominance throughout a vast lapse of time (from the era of the Upper Trias to that of the Purbeck beds) of a low grade of quadrupeds; and thus persistency of similar generic and ordinal types in Europe, while the species were changing, and while the fish, reptiles, and mollusca were undergoing vast modifications, raises a strong presumption that there was also a vast extension in space of the same marsupial forms during that portion of the secondary epoch which has been termed "the age of reptiles." But, it may be asked, might not these have been conveyed by the tertiary drift from the southern hemisphere? New Zealand, extensive, well-wooded, endowed with a climate varying from the cold and wet of North Britain to that of the sunny south of France, is—except a native rat already referred to, but which may yet be classed as doubtful—without one living native representative of the animal kingdom, the extinct Moa being the only known ancient type of terres-

trial life. By what agency was it dispeopled? It is more than doubtful whether her present Maori race originally belonged to the soil. She possesses, although on a limited scale, the same tree-less plains as the Pampas of Mexico, the same rounded grassy elevations as the *Campos* of the Amazonian basin; the same raised beaches as do the valleys of the Somme and the Meuse. Has she not likewise been swept bare of all animal life by a deluge—in the very focal direction of which she stands? Her isolated position would have proved a bar to subsequent re-inhabitation of animals. Further on we show that man came later on the scene.

May we not also ascribe to similar diluvial causes the sudden disappearance of animal species, and replacement by others, at certain geological epochs, in Europe and elsewhere? It is arbitrarily assumed that Nature had become tired of her former animal creations, and, without apparent cause, destroyed them at a blow; and yet, in the Kangaroo, she has retained the oldest of all.

We merely tread on the threshold of this great and important question as to the action of recurring deluges, as affording means for the dispersal and partial destruction of animal life, and as the chief agent in producing alterations on the surface of the globe. This digression may be readily excused if it serve only to bring fresh life to the subject and suggest new thoughts to the mind.

Allusion has been made to the extinct elephants, referred to by Sir Roderick Murchison in his Address to the Royal Geographical Society for 1866, "the heads of which," he says, "were, for the most part, turned towards the South; as if the animals had been retreating southward, when caught, either by an inundation proceeding from the North Polar regions, or by a change of climate, due to a wide elevation of land, whereby their former pasture-grounds became converted into the frozen soil in which the mammoths have been preserved to this day. All Northern Siberia, which is now glacial, was, during the age in which the mammoths lived, covered with a vegetation adequate to support vast hordes of these animals even up to the seventy-fifth degree of north latitude.* It may be inferred that

* Notwithstanding the wide-spread material witnesses which, geologists themselves admit, bear undoubted evidence of a great diluvial epoch, yet, because fossil vegetation and animal remains, proper to a temporate climate, are now found in the Boreal regions, they hold that those now frigid lands must at one time have enjoyed such a semi-tropical climate as we now have in the South of Europe. Whereas, if we adopt the well-supported evidence of diluvial agency in transporting what are now the fossil remains referred to, the contradictory enigma is at once solved. On the other hand, if we grant the climatic view to be correct, how are we to dispose of the *fact* revealed to us in the fossil animal remains which have for untold ages past been exhumed from the vast diluvium in which they were—in ice, sand, and clay —interred? A *genial* climate could not co-exist with *ice!*

the chief masses of such marine drift were deposited while a prodigious change of climate was being effected over the northern hemisphere. When the great, and, possibly, sudden, change of climate occurred, by which the mammoths were destroyed and entombed *in situ*, Northern Siberia was largely inhabited by these animals." In place of adopting the assumed theory put forward by Sir Roderick, that Siberia was possessed of a temperate climate at the period of its assumed inhabitation by mammoths, may we not reasonably inquire why those animals, to whom a temperate climate was essential, did not migrate southwards as the change gradually progressed, and not have waited until overtaken by an icy temperature inimical to their existence? The present animals of northern regions instinctively obey this law of self-preservation; and why not then, as now? Is it not rather a gratuitous assumption altogether to suppose that North Siberia possessed the temperate climate ascribed to it? and is it not equally assumptive to suppose that, because we there find the fossil remains of the mammoth, such an inhospitable region should have been the habitat of "vast herds" of gigantic animals, whose consumption of food would be so great that none but a semi-tropical climate, with its quick and succulent growth of vegetation, could have supplied their wants? If we are told that the

mammoth was clothed with hair, to enable it to dwell in a cold climate—therefore it did dwell in cold North Siberia—we take leave to object to that deductive conclusion. The Indian bear has an exceedingly thick coat of hair, yet it chiefly inhabits the hottest part of India. But we deem the food question both valid and insuperable. No such extreme northern winter season would have permitted the growth of food in sufficient quantities for such huge feeders. There is, also, the important difficulty of light; when the Boreal regions would be enwrapped in their long winter darkness vegetation would cease. Thus, this important objection exists, even if we put aside the question of climate.

Among the latest discoveries relating to the assumed ancient climate of the north polar regions is the natural history fossil plants recently discovered by Mr. Whymper, whose collection consists of ninety-five species, indicative of a climate similar to South Italy. "Such being the fact," says Sir Roderick Murchison, "geologists are now dragged into the grand cycles of certain astronomers, who endeavour to account for the wonder by carrying us back hundreds of thousands of years, to a period when the earth, by a change of axis, presented its now Arctic and Antarctic regions to the direct action of the rays of the sun." The results springing from this action—which the reader must bear in

mind—are founded on an astronomical fact, which is explained in Part II.

Thus let us hope that the dawn of a new geological belief is at hand, which shall embrace the true cause of the fossil mammoths, and other pachyderms, being found buried beneath the pliocene strata of Siberia, and on the banks of the huge rivers which empty into the Icy Sea, when the acknowledged agent of these momentous events will be recognized as the Great Diluvial of the last but one deluge from South to North.

The traditions of the Siberians assert the occurrence of a deluge, and disown the mammoth as a native of their country, saying, "They came on the great waters of the flood."

"There is not," says the Russian Professor Pallas, "in all Asiatic Russia, from the Don to the extremity of the promontory of Tchutchis, a stream or river, especially of those which flow in the plains, on the banks of which some bones of elephants, and other animals foreign to the climate, have not been found. But on the *more elevated regions they are wanting*, as are marine petrifactions. But in the lower slopes and in the great muddy and sandy plains—above all, in places which are swept by rivers and brooks—they are always found, which proves that we should not the less find them throughout the whole of the country if we had the same means of searching for them."

The more we advance towards the north of Russia, the more extensive are the fossil bones of the elephants met with. Travellers tell us of islands in the Icy Sea which are literally a conglomerate of ice, mud, sand, and bones. Billing's "Voyage," speaking of one of these (Indigherka) situated opposite the mouth of the Lena, says, "The whole island (which is about thirty-three leagues long), except three or four small rocky mountains, is a mixture of ice, bones, and sand; and as the shores fall, from the heat of the sun's rays thawing them, the tusks and bones of the mammoth are found in great abundance. To use Chroenoff's own expression, the island is formed of the bones of this extraordinary animal, mixed with the horns of the buffalo *(bos)* and small horns of the rhinoceros. New Siberia and the Lachow Islands, off the mouth of the Lena, are, for the most part, only an agglomeration of sand, ice, and elephants' teeth. At every tempest, the sea casts ashore new quantities of mammoths' tusks; and the inhabitants of Siberia carry on a profitable commerce in this fossil. Every year, during the summer, innumerable fishermen's barks direct their course towards the "Isle of Bones;" and during the winter, immense caravans take the same route. All the convoys are drawn by dogs, and they return laden with mammoths' tusks, each weighing from 150 to 200lbs.; some have been found which weighed

350lbs. The fossil ivory from the "Isle of Bones" has served as a quarry for this valuable material, for export to China, for the past five hundred years, and it has been exported to Europe for upwards of one hundred years. But the supply from these strange mines are apparently undiminished and inexhaustible. The above evidence (from much more not given) affords so vivid a picture to the mind's eye as to the vast abundance of the fossil bones of the strong-hided animals only, that, to read from the pages of Pallas, we can almost fancy we see them swept along by the fierce waters of a deluge until they had reached their watery goal and final destination, the great polar grave-yard of the pachyderms, borne thither on the waters of the pliocene deluge from South to North. The reader will not have failed to notice the remarkable fact that the "pachyderm" animals only—the tough-skinned and strong-boned —are thus found in the great diluvial of the Arctic region. Why? Because the animals of weaker formation would have been crushed piece-meal whilst subject to the action of the dread waters of the deluge.

In the quotation from Pallas, it should be observed that he is particular in relating the fact that the vast mines of fossil bones of North Siberia are found only in the plains and valleys washed by rivers. None are found in the hills and mountains.

Are we not justified, then, in drawing the conclusion, that had the animals whose fossil bones are now found, lived in Siberia at the period of its assumed possession of a temperate climate, which afterwards changed to a frigid temperature, would not these strong animals have migrated south to a more temperate region? If we, on the other hand, ascribe their destruction to fluvial causes, no ordinary flood would have caused it, as they would have sought safety on the hills and mountains. But where do we find their remains? except as forming a conglomerate of ice, sand, mud, and millions of tons of the bones of these strongest of all mammalian swimmers, had not the flood of waters in which they were engulphed been of a vast and sudden character, which defied escape to the hills even had they inhabited the land which proved their grave. To what other conclusion can we, then, arrive at, than that their dead and bloated carcases floated in the turbid diluvium in which they were subsequently entombed; their true habitation from which they were wave-swept being the sunny land of South America, which has not only been denuded of its animal life,* but which some of our most eminent geologists assert has been, without doubt, subject to a devas-

* Darwin discovered in the clay cliffs of South America large quantities of mammalian pachyderm remains.

tating flood? Of late years we have obtained convincing proofs that the mammoth, and many other extinct mammalian species, very common in caves, occur also in undisturbed alluvium, embedded in such a manner with works of art as to leave no room for doubt that man and the mammoths co-existed, and also died together, except a remnant of the reason-gifted of the former.

But one circumstance more convincing than any other is related by Dr. Schmerling. From all the indications he found in the forty caverns he explored, in some of which the bones of man and of extinct animals were found together—the bones of man so rolled and scattered as to preclude all idea of their having been intentionally buried on the spot—it was manifest that the organic and inorganic contents of the caverns had been swept into them by streams communicating with the surface of the country. Land shells, fresh-water fish, a snake, as well as the bones of several birds, were amongst the mass, probably rolled in the beds of streams before they had reached their cavernous destination.

Professor Huxley remarks, "There can be no doubt that the physical geography of Europe has changed wonderfully since the bones of men, mammoths, hyenas, and the rhinoceros, were washed pell-mell into the cave of Engis;" and Sir John Lubbock says that "at Abbeville, on the Somme,

there are found in the peat, at a depth of fifteen feet, remains of the Stone period, which, we believe, from the researches in Denmark and Switzerland, to be of an age so great that it can only be expressed in thousands of years; yet these are all subsequent to the diluvial excavation of the valley." Sir C. Lyell confesses that, "after a very patient examination of the comparative antiquity of the fossils, it is impossible to come to any other conclusion than that man was introduced into the world at an earlier period than geologists have believed."

From the examination of the tombs, temples, and pyramids of Egypt, it was placed beyond controversy by Bunsen, that there had been an organized system of government amongst the Egyptians for at least ten thousand years; and he concludes, from the data furnished by that examination, that it would require at least another and further period of ten thousand years to coincide with his theory of Egyptian civilization. Geologists may be said to have taken up this branch of their science where the monumentalists left off. At first they approached the matter cautiously, in the manner we have just quoted from Sir Charles Lyell (who "confesses" that geologists have not given a sufficiently remote period to the appearance of man), no doubt dreading the power of the ignorant, selfish, and superstitious; and often drawing deductions stulti-

fying to geologic science, and their own genius, which were not borne out by the facts stated.

For example, the philosophic Darwin, in his "Researches," says, "It is impossible to reflect on the changed state of the American continent without the deepest astonishment. The mind at first is irresistibly hurried into the belief of some great catastrophe; but thus to destroy animals, both large and small, in Patagonia, &c., up to Behring's Straits, we must shake the entire framework of the globe." To this it may surely be replied, "The animals have been destroyed; therefore, the entire framework of the globe has been shaken." How these alternate deluges, of which we are treating, affect the races of man in the two hemispheres, is apparent, even at the present day. The native Indian tribes, remnants of whom inhabit the southern part of the North American Continent, represent, there can be no doubt, a race much older in the world's duration than those races which have supplanted it. And in Australia a still older race is fast disappearing—a race in which we behold, not only the oldest, but the lowest, type of mankind; a race unfitted for civilization—nay, its very contact with civilized life, with its restraints and usages, hastens its destruction; a race so near the brute creation that it might be appropriately classed with it, if it were not for the power of language and the only ingenious thing in

its possession—the boomerang. The reason why Australia could not, until the appearance of the white race, make any progress in civilization, conceding even that the natives as a race were capable of it, is easily found in the nature of the country. It wants moisture, and nutritious plants, and seeds for man or beast. Extensive tracts of land are required even to feed a flock of sheep; wild animals are scarce in large districts; and Europeans, who should have to rely for their food upon what Australian vegetation could supply, would share the melancholy fate of Burke and Wills, when they tried to eke out their miserable existence by eating the wretched nardoo fruits of Australian swamps. So long as these conditions were not remedied, there could be no flocking together of men—no founding of cities, towns, and villages—no permanent interest in property, and no step forward in improvement, until the introduction of cultivation, flocks, and herds, by the civilized white man from Europe. All was hopeless stagnation. But if, under these unfavourable conditions, man has existed in Australia for scores of centuries, we may conclude that he could exist in Europe and America, even during the *eocene* period, when the same, or a closely similar, climate, vegetation, and, perhaps, fauna, prevailed there. We may also be sure that, with such surroundings, whatever his race may have been,

he could not have arrived, at that early period, at a much higher degree of civilization than the miserable aborigines of Australia, who are fast hastening to extinction. But climate, however, always stamps its seal on the human race. A moderately cold climate creates in man a desire for animal food, with its carbonaceous fat. This elicits ingenuity in the designing and the manufacture of weapons for the chase, and generates courage in the attack of wild animals for the attainment of his instinctive desires. Nutritious food not only develops the physical, but also the mental organs of man; hence, progress is made, step by step, on the path towards civilization.

But along with advancing civilization in the Old World there has occurred a considerable alteration of climate. We know that the average rain-fall in Europe is steadily increasing year by year; that in four years the increase in Belgium was from 49 to 106 millemetres; that the northern ice-cap is slowly increasing. The larger part of Northern Iceland is no longer habitable; notwitstanding that less than eight hundred years ago it bade God-speed to the first discoverers of America, and during the eleventh, twelfth, and thirteenth centuries created and maintained, amidst its snows and volcanic fires, a literature that would have done honour to the happiest climes in Europe. The same may be said of the Faroese of the same Norse family, who, so

early as the eighth century, had a similar literature of their own, full of manly gist and masculate expression. So much for the innate courage, enterprise, and learning of the bold Norsemen, from whose valiant loins we spring. The Alpine and Norwegian glaciers grow larger every year, and Greenland is rapidly disappearing beneath the waters of the Arctic circle. We know also that during the thirteenth century, and much later, the vine grew freely and produced fruit in the open air in all parts of England, where it would scarcely put out leaves now. Two or three hundred years ago grapes formed a common present to circuit judges from country gentlemen. The refrigeration of climate, from the time of the older to that of the newer pliocene strata, was inferred by the late Edward Forbes, in 1846, from a study of the "Crag-shells." These fossils have a direct bearing on the relations of the human and glacial periods, and clearly point to a gradual refrigeration of climate from a temperature somewhat warmer than that now prevailing in the latitude of Britain to one of intense cold. The number of large icebergs which float annually to great distances, both in the northern and southern hemispheres, is extremely great, and the quantity of stone and mud carried about by them is enormous. Some floating islands of ice have been met with from two to five miles

in length, and from one hundred to two hundred and twenty-five feet in height, above water, the submerged portion, according to the weight of ice relatively to sea water, being from six to eight times more considerable than the part which is visible; thus the highest mentioned would equal a total height of one thousand five hundred and forty-five feet. Such masses, when they run aground on the bottom of the sea, must exert a prodigious mechanical power, and may plane, groove, and polish subjacent rocks, after the manner of glaciers on the land. Hence there will often be no small difficulty in distinguishing between the effects of the submarine* and the supramarine agency of ice. Some years ago, a large erratic block about four feet in diameter was dug out of the boulder clay at Icklington, which was found to consist of a hard silicious schist, apparently a silurian rock, which must have come from a remote region—a fact which would clearly indicate that it was brought to the place where found by some iceberg, or similar phenomenon.

Another action of glacial drift may be here appropriately mentioned. In 1852, no less than seventeen human skeletons were found in a cave near a

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* It is said that such groovings have been found in the streets of New Brunswick.

spur of the Pyrenees. They were proved to be of the post-pliocene period (wherein glacial drift occurred), and the bones of the adults implied that the race was of small stature. This is the sole exception to the discovery of human bones, in any quantity, of the post-pliocene period; for while there is no want of bones of mammalia belonging to both extinct and living species, in the tool-bearing drift of that period, not a single human bone has yet been met with in the alluvial sand and gravel of the Somme. Of course, this may be rationally accounted for by assuming that the exercise of their reasoning powers enabled the human beings of that place and period to escape the general deluge which followed the gradual elevation of the northern seas prior to that event, by retiring to the mountains. However, this absence of every vestige of bones belonging to the population by which so many weapons were designed and executed, is brought forward by geologists, who have probably not given the deluge theory due consideration, as a puzzle affording, they admit, a most striking and instructive lesson in regard to the value of negative evidence, and illustrating the extreme imperfection of the geological record, of which even they who are constantly working in the field cannot easily form a just conception. Thus, surprise is expressed in not finding flint implements in the summit sea beaches of the

valleys of the Somme and the Meuse, notwithstanding the profuse number discovered at lower levels. This fact, recorded by Lyell in his "Antiquity of Man," is to us replete with inductive evidence that the human inhabitants in those localities at that period may have resided in secure contentment and safety during the gradual rising of the sea and the formation of the lower beaches, and these may have become the chance depositaries of their lost flint implements over a long period of time; whilst the summit beach, having probably been formed at the period of the last deluge cataclysm, the inhabitants (as we have before stated) had either fled in time to mountain heights, or had been overtaken and drowned in that catastrophe, before their implements could have been scattered in given localities by the chance circumstances of every-day life which a long residence in one spot would have entailed.

In both hemispheres there are sea beaches from a thousand to fifteen hundred feet high, with stranded trees, on rock ledges above, turned into silica. These and other elevated fluviatile stratifications have been hitherto arbitrarily assumed to be due to "upheavals of the earth," whereas there is now little doubt that they are due to former ocean levels, formed by periodical deluges.

It is cutomary to speak of the *valley* of the

Amazon, although, in reality, there is no such thing. The whole of Eastern America is one oblong plain, divided by a few elevated transverse ridges. Humboldt has pointed out that a rise of the sea to the extent of 1,200 feet,* would carry the waters of the Atlantic to the foot of the Andes, and cause the entire region to be again what it was in times geologically recent—the bed of a shallow sea. Various opinions have been advanced in regard to the deposits of the entire area; but the most startling of all is that of Agassiz, whose predilections for glacial agencies are well known. He boldly covers the entire continent during the glacial period with a mass of snow and ice from ten to fifteen thousand feet in thickness, and believes that the strata in question are merely a vast morain formed by the melting snow of ages. It has also been urged that the forces of nature always act slowly and by an almost imperceptible motion. In a normal sense this is true, but the glacial period does not bear out such views. It could be owing to no less potent agency than the disruption of the normal state of nature, occasioned by a polar deluge, that "the whole of Norfolk was made a heap of rubbish," composed of every known stratification

* If not from deluge causes affecting ocean levels, why is this ever-recurring 1,200 feet of sea level marks coincident with the raised beaches in both hemispheres?

of the world, mixed up with pachyderm mammals, serpents, crocodiles, and sharks of the torrid zone, in juxtaposition with the walrus, whale, and narwhal of the Arctic Ocean, lying side by side with the horse, wolf, bear, pig, bison, and deer, including in the latter species the large Irish elk. There is such a vivid, old world, and instructive picture of this country, written by Mr. J. E. Taylor, that I have pleasure in introducing a portion here.*

In describing the blue clay cliffs in the neighbourhood of Cromer, on the Norfolk coast, he says: "Cropping out along the feet of these cliffs is a geological phenomenon possessing intense interest even to a non-scientific reader. It is neither more nor less than an old forest-bed of immense antiquity. After one of the north-west gales already mentioned, there may be seen extensive patches and sheets of semi-indurated mud and turf which extend to the very margin of low water, and continue beneath it seawards for miles. This is the soil upon which the old forest grew, and the vegetable exuviæ it left behind. When examined, it is seen to contain hundreds of the stools of trees, some of them four or five feet in diameter, and each with its roots spreading into the surrounding mud. This old forest-bed has been traced into Suffolk for a dis-

* "Under the German Ocean," 1870.

tance of nearly forty miles, whilst its accurate landward and seaward extensions are unknown. That it forms no small portion of the floor of the German Ocean there can be little doubt. Fishermen are constantly dredging up portions of its vegetable soil, its old gnarled tree-trunks, and its numerous mammalian remains. Underneath the sea hereabouts is one of the most striking evidences of an old land-surface known to geologists. Were this sea-bottom to be upheaved only forty yards (a mere trifle compared with what has taken place since the forest grew), then the whole of this strange phenomenon would be laid bare. Owing to the shallowness of the sea, dry land would stretch away from Flamborough Head to Heligoland and Jutland. Norfolk would once more be connected with the great Germanic plain, and England become a westward prolongation of the European continent. The 'deep-water channel' skirting the eastern coast would, under such circumstances, become the course of the Thames and its tributaries. Such a change would, in fact, almost restore to us the terrestrial conditions which existed when this now submarine Norfolk forest-bed flourished.

"The geological age of this phenomenon is *pre-glacial;* that is to say, it dates before the period of intense cold, when an Arctic climate replaced our own, and before Great Britain was sunk beneath a wintry

sea, all but the tops of her highest mountains. The present cliffs under which the buried forest extends, since it rejoiced in its arboreal glory, have been formed as an immense mud-sheet along the bottom of this glacial sea. The huge masses of sand, gravel, and clay strewn over the northern hemisphere down to the fortieth parallel of latitude, have all been elaborated since the submarine forest ceased to exist. Our mountains have been sculptured by inorganic forces into their present shapes, our valleys have been eroded into their prevailing fertile and smiling conditions, old continents have gone down like foundering ships, and new seas overwhelmed their areas, since the forest-bed was transferred from its superficial condition. And yet, geologically speaking, these vast changes are hardly to be compared to the mighty events that took place in ages long antecedent.

"The most striking peculiarity about this forest-bed is the extreme contrast between its animal and vegetable remains. The latter, with one or two exceptions, almost exactly resemble the present flora of Great Britain; whereas the former are utterly unlike any animals now living in these islands. All the geological changes above referred to have, therefore, taken place within the lifetime of existing species of plants and trees. Elsewhere in this country we have manifold evidences of old land-

surfaces. Our coal-fields are full of examples; and the Portland 'dirt-bed' of later date, with its petrified trees allied to tropical forms, is a later illustration. But in the Norfolk forest-bed we have evidence of a temperate climate nearly allied to that now enjoyed by ourselves, as well as striking proofs of our former continental prolongation. A close examination of the soil of this old forest, which is matted into thin layers, reveals the presence of innumerable wing-cases of beetles, *fresh-water* shells, &c. It certainly is singular to find fresh-water strata forming the floor of the sea. Among the stumps of trees so plentifully dotting the black surface are chiefly the Scotch and spruce pines, and branches, roots, and leaves of yew, willow, alder, oak, sloe, and hazel. The matrix is frequently of a *turfy* structure, and in its dark appearance shows the presence of a great admixture of vegetable matter. Its entire suite of arboreal remains reminds one strongly of the adjacent Norfolk land-surfaces, and extensive muddy marshes. The most advanced opinion relative to this forest-bed is that it is the site of an old river delta, rich in the various mineral elements necessary to a luxuriant vegetation. The fresh-water shells and other remains certainly bear out this idea, which is further supported by our finding such fossil plants as the buck-bean, the yellow and white water lilies, hornwort, pond-

weed, &c. The occasional occurrence of marine and brackish water-shells shows that the sea was not far distant, and tells how its waters made periodical excursions over the low-lying portions of the old delta. In fact, the various circumstances attending the deposition of the vegetable remains indicate conditions exactly like those of every-day life. Hazel-nuts are found perforated by weevils, fir-cones are bitten away as if by squirrels, and even the gum which exuded from the pines may be met with as so many lumps of resin, just as in older strata by the Baltic it is found as amber. The water-lilies bloomed and seeded, although human eyes were not opened on the smiling earth for ages afterwards. The stagnant pools were faintly streaked and rippled by 'spinners' and water beetles. Judging from the fineness of the mud or soil, it must have been a long time in process of formation. At Cromer the stratum attains its greatest thickness, which never exceeds a few feet. Here also one meets with the greatest quantity of vegetable remains. At Runton, a little farther along the coast, the soil of the forest-bed expands into a thick fresh-water deposit. The only tree not indigenous to Britain whose trunks and cones are found is the Norway spruce-pine. This is a native of a colder climate than our own, although we have naturalized it in this country pretty easily.

The Scotch fir, also abundant in the same bed, has been confined within historical times to the land whence it takes its name. Our then connexion with the Continent, however, will explain how such northern trees grew in English latitudes; whilst the subsequent submergence of Great Britain during the glacial epoch, is sufficient to indicate the causes that exiled them until they were re-introduced. It is well worth the while of the geological student to visit these wild and solitary Norfolk coasts, especially after a long-continued north-west wind. If he go at any other time, he must take his chance of finding any portion of the forest-bed visible. The waves have an immense power of silting up, as in stripping off, their own work. As the sea is constantly gaining on the land, after every storm more severe than usual, new sets of sub-fossil trees are constantly being brought to light. A better indication than this could not be wished for of the persistent character of the old forest, as well as of its landward extension.

"Familiar and matter-of-fact as are these floral details, so that they seem to differ little from what we should find in any extensive peat-bog in our own times, the difference is more than atoned for by the associated animal remains. These are met with both in the forest-bed proper and in an overlying stratum, which has earned for itself the name of the 'elephant

bed,' from the large quantities of teeth and bones of that animal which have been disinterred from it. Thanks to the researches of the Rev. John Gunn, the mammalian remains of the forest-bed are now pretty well known,—elephants of at least *three* species, the largest of which, according to the late Dr. Falconer, could not have been less than sixteen or seventeen feet high. The tusk of one of these animals has been dug out, and although nearly three feet were broken off, it still measures ten feet in length, and is nearly three feet in circumference. The other animals known are a species of horse, much larger than the biggest Suffolk cart-horse, together with abundant remains of bear, hippopotami, rhinoceri, and beavers twice as large as any now living, deer, oxen, goat, water-rat, &c. Many species of these animals were of unique form. One kind of deer, named after the veteran geologist, Professor Sedgwick, had antlers extending six or seven feet on each side the head, and four feet in height. The remains of one 'missing link' in the animal world have turned up in this deposit, connecting the ox with the deer, its horns or antlers possessing characters common to both. Such is a brief outline of the fauna of the Norfolk forest-bed. It existed long before the German Ocean had cut its way through the boulder clay and occupied its present site. It is difficult indeed for one to asso-

ciate an English forest with the heavy tramp of browsing elephants, or English rivers with wallowing hippopotami and rhinoceri. And yet here is the delta of an old river certainly as vast as the Rhine. In it we have evidence of gigantic beavers building their dams and seeking their finny prey. Herds of deer were attracted by the luxuriant vegetation and the fresh sprouts of familiar shrubs. Wild horses galloped over the bleak chalk plains of Norfolk and Suffolk, and goats and oxen wandered as their nomadic appetites prompted them. Under the German Ocean, with the exception of that portion stripped off by its fierce currents and strong tides, lies the great sepulchre of these pre-Adamite animals. A semi-hardened soil, containing fresh-water shells and land and aquatic plants, is the floor over which one of the most dangerous seas in the world storms and tumbles. The pre-human epoch is brought into contact with the present in strange affinity. Many a goodly ship has found a resting-place on old forest ground, and the bones of brave mariners who fought hard for dear life lie commingled with the remains of old world elephants, hippopotami, rhinoceri, and bears.

"As an indication of the numerous bones and teeth which have been washed out of the original matrix of the forest-bed, I may here mention that altogether many thousand elephant's teeth have

been dredged at various times from the sea-bottom by Norfolk fishermen. In addition to these have been great numbers of fossil tusks, &c., many of them covered with marine worm-tubes, oysters, and anomia. At Bacton remains of the narwhal, walrus, and the common whale have been met with. Their occurrence proves that, towards the conclusion of the forest-bed period, a gradual change of level had commenced, during which these animals were stranded and their bones entombed. This submergence, it is known, went on until a tolerably deep sea spread farther and farther inland, and eventually all but the tops of the high hills in Great Britain were covered by it. Of the time taken up by the process, we can form as little idea as we can of the vast distances which separate our planet from the Milky Way. But we have their result in those superficial deposits of sand, gravel, and clay, so necessary to agricultural wealth and prosperity, and without which England would have been little better than a 'waste howling wilderness.' Under the German Ocean lies one of the latest chapters in geological history—an epitome of old world animals and plants, many of them the direct ancestors of existing species — the details of whose former humble life may be read off as plainly as antiquaries have done the manners and customs of ancient Herculaneum. Just before the great ice-sheet

swathed northern continents, we catch a glimpse of peaceful English forest life, hardly differing in its floral character from that of to-day, although hundreds of centuries have meantime rolled away to join the mighty host which preceded them. Here is one more secret which the ocean would have hidden, had it not been for the pertinent demands of modern science."

In estimating the progress of time as connected with the carboniferous era, nations who are now inhabiting the countries where there are deposits of vegetable fuel were enwrapped in barbarism but yesterday, as it were; whilst those of the great non-carboniferous areas of the earth boast of an antiquity which again is full of another antiquity still more remote. No one can deny this remarkable fact; nor should the action of the last deluge be doubted as the direct cause—the carboniferous fuel and boulder track marking the terrible focal path of its raging waters. It is worthy of remark also, in passing, that the Scripture Man—the Adam of Genesis—should first appear in Central Asia, a country having no traces of the last deluge.

The question naturally arises to the mind, Did a remnant of the human race, in previous deluges, escape to the mountain summits—as we are told Noah and his family did in the last—and there witness that "crash of worlds," the blinding light-

ning, and the deafening thunder outbellowing the roar and rush of icebergs and swirling seas; all animal life fleeing for the safety which few would find; the hurricane laying prostrate every tree, which the rushing, rising, and overwhelming waters would carry off, to lay down in high-piled swathes for fuel to serve man's future wants? What a spectacle to witness—such a mighty rush of ocean, bearing over its angry surface a continent of dis-jected ice-mountains, huge rafts of riven forest-trees, with dead animals swashing side by side; the granite-laden icebergs grinding down islands of coral,* and ploughing up the sleeping sand from ocean depths; the fearful waters hurrying the re-gurgitating, conglomerate mass onwards towards the opposite pole, laying down fresh geological strata in their course, in which we now find buried vegetable and animal fossils!

Mute witnesses of a former deluge still exist, on the scored sides of mountains, in the scattered sweepings off other lands, together with its well-marked track of stranded erratic blocks, one of

* How else are we to account for the immense thickness of limestone strata formed in the northern hemisphere, where the *coralline* could not exist? In Europe we find buried in conglomerate masses the very broken-off pieces of coral itself. On all the shores of the southern hemisphere, in whose seas coral abounds, there is abundance of limestone everywhere cropping up through its surface.

which, at Prevalto, in the European Alps, would weigh 4,166 tons.* Such as these are strewn broadcast over North America, Central and South Europe, all left, in consistent courses, upon a soil foreign to its geological order. It is thus that the future highly-civilized Man, with his great stores of learning, his rare labours in art and science, his ingenious implements, and refined aids to civilization, is swept away without a stray trace of the wondrous mechanical instruments by which he may have weighed this globe in a balance, determined the position and density of other worlds; and not one sample stone left to tell of the whereabouts of his architectural genius. This is a fearful picture to contemplate as the future destiny of the human race, the end of the achieved glories of cultivated intellect and skill. Deprived of all the implements of civilization, the human remnant falls back into benumbing barbarism, until subsequent generations essay the first step in the ladder of improvement, and slowly climb its difficult height, each step an age of centuries.

It, however, becomes a question for consoling

* This measures in feet $50 \times 40 \times 25$, equal to 50,000 cubic feet, which, at 12 cubic feet to the ton, would weigh 4,166 tons; and it will give the reader some idea of the immense island masses of ice in motion during the great cataclysm of the last deluge.

consideration whether, with man's present scientific and mechanical knowledge and resources in combating the forces of nature, coupled with the important fact that the possessors of these advantages now, probably, for the first time, occupy both hemispheres—whether again civilized man can be cast back into the darkness of antediluvian barbarism.

CYCLICAL DELUGES.

PART IV.

CYCLICAL DELUGES.

PART IV.

COAL FORMATIONS: THEIR GEOGRAPHICAL POSITION WITH REFERENCE TO THE DEPOSITION OF CARBONIFEROUS FUEL BY DELUGE ACTION.

"THERE IS SORROW ON THE SEA; IT CANNOT REST. WHAT AILETH THEE, O THOU SEA?"

We come now to consider the phenomena by which carboniferous mineral has been deposited in various positions, and in different parts of the earth. After a close study of this subject, we have arrived at the fixed conviction that, from their geographical position, all the great coal-fields known indubitably point to fluvial agency in their formation.

Lecturers on the subject of coal formations generally fear to depart from the orthodox doctrine of "submergence," in accounting for the phenomena, yet often exclaim, "How except by drift theory were they to account for tropical plants and the fossil remains of strange animals in the north temperate zone?"* Thus wavering in unsatisfied doubt, they may well say, like the gallant Macheath—

* How, indeed, when we find vegetable fossils of a semi-tropical growth in close Boreal neighbourhood with entire carcases of antediluvial elephants entombed in a conglomerate

"How happy could I be with either
Were t'other dear charmer away!"

For although they reject the drift theory for no other reason that we can see than that it had not the "suffrages of the scientific world," and lecturers do not wish to be seen in bad company, yet they cling to it like the mariner to his compass, without which they are "all abroad" on a sea of conjecture. For ourselves, we object to the theory of "submergence," so frequently advanced, because our reason revolts against it, as being an insufficient agent, and irreconcilable in its action with the results ascribed to it, especially as it affects the formation of coal.

"Geology (like astronomy) is partly a deductory science, made up of constantly recurring discoveries, which give birth to new phases of thought; these in turn teach how to arrive at new deductive ideas that will convince reason, and, at the same time, be in accordance with the general laws of nature, and thus displace doubtful and disputed interludes of false conclusions, until the time arrives when some long-rejected stone of evidence, being skilfully shaped to build up a theory consistent with reason,

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of mud, sand, ice, and mammal bones of gigantic pachyderms; which striking phenomenon is (by a happy reticent forgetfulness of the icy element!) accounted for by many geologists by assuming that the present poles were once the equator of our planet! Yet the deluge waters, as the carrying agent from their native soil, at once solves the apparent contradiction.

becomes its very keystone. In some cases, without even the accession of new discoveries, fresh channels of thought sometimes sap, and gradually undermine, former cherished opinions, and in time establish a new theory, which a reasonable conviction assures us is the right one.

"Thus, at the early part of the present century, Werner, who at the time was the acknowledged Linnæus of mineralogy, first put forward the Neptunian theory, which ascribed to aqueous agency the formation of trappean and granite rocks, although their igneous origin had been ably demonstrated by Fortis, Desmarest, Faujis, and Arduing; yet Werner's new theory was adopted by geologists, and its tenets persistently adhered to, until Hutton, after a long struggle, dispelled it by his teachings, and ultimately triumphed in restoring them to their igneous order of rocks. We now look back with wonder that such an illusion should ever have been entertained.

"'We write in sand, opinions grow,
And, like the tide, our work o'erflow.'"

We have read over Sir Charles Lyell's carboniferous chapter several times in order thoroughly to understand it; and although we have a profound respect for his genius as a geologist, we cannot help thinking that the chapter we refer to is the weakest and most unsatisfactory in his "Elements of Geology."

By the general reader we may be excused for explaining that what are called coal measures not only include coal-seams or coal-beds, but also the several intercalary strata of sandstone, limestone, gravel, shale, carboniferous slate, clay, millstone grit, and sometimes igneous rock, such as trap or granite, &c. When we consider that some coal measures have a proved depth of 12,000 feet, and (with the exception of igneous rock) that each stratum has been deposited by fluviatile agency, and that sandstone strata of 500 feet thickness sometimes intervene between vast seams of coal—the latter three to five times repeated, with many intervening strata of rock, &c., separating them, the whole having a total depth varying from that given above to within a few feet from the surface;* that,

* In one section, near Swansea, in South Wales, where the total thickness of strata is 3,246 feet, we learn from Sir H. de la Beche that there are ten principal masses of sandstone; one of these is 500 feet thick, and the whole of them make together a thickness of 2,125 feet. They are separated by masses of shale, varying in thickness from 10 to 50 feet. The intercalated coal-beds, sixteen in number, are generally from 1 to 5 feet thick; one of them, which has two or three layers of clay interposed, attaining 9 feet. At other points, in the same coal-field, the shales predominate over the sandstones. The horizontal extent of some seams of coal is much greater than that of others, but they all present one characteristic feature in having each of them what is called its under-clay. These under-clays, co-extensive with every layer of coal, consist of arinaceous shale, sometimes called firestone, because it can be made into bricks which stand the

by adopting the theory of submergence, each stratum would take myriads of ages to produce the results which geology reveals to us,—we again confess to an utter unbelief in the theory of submergence, so far as being the sole and universal agent in the formation of coal.

We may very reasonably be asked by what agency the stratified rocks attained such enormous depths. We reply, by the action of alternate deluge drift from pole to pole alternately, as set forth in Adhemar's "Révolutions de la Mer." * We give the following extract, but the reader should peruse the quotations given from it—only some half-dozen pages—when he will thoroughly comprehend the drift of our objections, and the object of our inquiries.

In our short extract it is asserted that "Noah's was the last grand deluge; Adhemar's is to be the next. Noah floated in safety through the vast inundation which bears his name; it is not likely

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fire of a furnace. They vary in thickness from 6 inches to more than 10 feet; and Sir William Logan first announced to the scientific world, in 1841, that they were regarded by the colliers in South Wales as an essential accompaniment of each of the one hundred seams of coal met with in these coal-fields.—*Lyell's "Elements of Geology."*

* M. Alphonse Adhemar, born at the close of the last century, was a French mathematician of great repute. See a full account of his theory in *All the Year Round*, Vol. III., p. 40; Article "Deluges."

that Alphonse Joseph Adhemar, author of the 'Révolutions de la Mer,' will enjoy the same good fortune, seeing that he was born in 1797, and that his deluge is not to happen before the lapse of six thousand and nearly three hundred years. The event, of which such long notice is given, is to be the result of physical laws relating to heat and gravity, and of certain well-known astronomical facts. The immediate cause of the cataclysm thus predicted is to be a disturbance of the equilibrium of the ocean—the inevitable consequence of a change of its centre of gravity. The seas, shallow in comparison with the mass of the globe, are spread over the greater part of its surface, so as to render it (were it flat instead of spherical) like a dinner-plate all but filled with water. Tilt the plate ever so little, and the water rushes to one side, leaving the opposite side uncovered. Shift the centre of gravity of the terrestrial globe, and the oceans must obey the new point of attraction as surely as the tides obey the moon. In Adhemar's deluge, the South Pacific, South Atlantic, and Antarctic Oceans are to be suddenly poured across the equator, to submerge our northern hemisphere. The sea is to take re-possession of its ancient bed, which we now occupy and cultivate. High grounds, rising above the level of the Southern Ocean, are to form the archipelagoes of a new Polynesia. Our

hemisphere, which is continental at the present day, is to become what it was before the last catastrophe—oceanic, and *vice versâ*. In the southern hemisphere, unknown continents are to spring from the abyss, raising their summits to the clouds, and are soon to be covered with what is called eternal snow—that is, eternal until the next oceanic revolution. In reality, the mountains will not rise; but the effect will be to all intents the same, by the retiring of the sea from that half of the earth's surface. By the depression of its level, the islands of the Pacific will at once become the culminating points of new chains of mountains. The continental hemisphere will then lie on the other side of the equator."

In the fluvial agency only of such a mighty rush of waters can we reasonably account for the enormous thicknesses of strata we have already quoted. By this periodicity of deluges, alternately, from pole to pole, at the intervals already named, the hemisphere which had last been submerged remains for ages under the ocean, until, by the gradual recession of the waters, it again rears its summit, to fit it to bear vegetation and support animal life. This process is now in action in the south hemisphere; whilst, on the other hand, the sea is rising in the north; and even within the memory of man has this been noticed. Our South Sea whalers now state another significant fact—namely, that

the icebergs, losing their hold of the Antarctic pole, are now more numerous than of yore.*

We shall now endeavour to bring forward facts relating to the deposit of carboniferous fuel, in which the positions on the map of all the great coal-fields exactly identify, geographically, with the deluges of Adhemar, as the fluviatile agents, in first denuding forests, and then conveying the floral spoil to the site of the future coal measures of the world.

If we turn to a good atlas on Mercator's projection, we are much struck with the fact that where the large coal-fields exist, the shores are coincidentally open for the reception of the deluge timber-drifts, which, we believe, are formed from the forests stripped from the old world soils by the ocean rush, and conveyed into what are now great gulfs, low-lying valleys, land-basins, and up estuaries, leading to present great rivers. We admit the fact of vast changes on the surface of the earth; but we believe that those changes are confined nearly solely to the formation of igneous rock, not to submergence; and that the summits of

* These bergs drift into warm latitudes and melt, whilst at the same time, an opposite action is now going on at the North Pole, where the extending glacier absorbs in its icy grip what the South parts with, and thus gradually increases the ponderous gravity which ultimately produces the deluge cataclysm.

sedimentary mountain ridges were once plains, since scored into valleys, and otherwise altered to existent shapes by glacial and fluvial agency; and that the profound thicknesses of sedimentary stratifications of the coal measures have been created by periodical deluges, whilst the intervening thinner strata are due to deposits influenced by the ordinary intermediate action of the tides during the lapse of time which intervenes between such alternate deluges.

If, as geologists assert, "Norfolk is a heap of rubbish" (in which we agree), formed of the geological sweepings of the earth—and, let us add, animal kingdom—is it too much to imagine that the Jura mountains were at first a swashed-up deluge shoal of calcareous matter and animal remains, afterwards ploughed into ridges by icebergs? Surely, these suggestive views (taken with the admitted facts of the submergists) are as much consistent with reason as the ever-sinking theory, so much at variance with our modern experience of denudation by the action of air, frost, and rain, on the higher lands, and the fluviatile erosion from, and addition to, low lands—not submergence.

As it may assist the reader in accompanying us in our survey of the principal coal deposits, we give the subjoined list of coal regions from Professor Bristow's "World before the Deluge":—

	Square Miles.
North America	310,500
Great Britain	6,200
France	1,550
Belgium	775
Rhenish Prussia and Säärbrück	1,550
Westphalia...	590
Bohemia	620
Saxony	66
The Asturias, in Spain	310
Russia	160
South America	Vast, but unestimated.
Islands of the Pacific...	Unknown.

To which we may add the scarcely-touched coal-fields of the North of China, North Japan, North Formosa, North Borneo, and North Labuan. These formations were evidently furnished by fluviatile timber-drift from the North through Behring's Straits, and down the Sea of Kampschatka.

Lyell, in his "Elements of Geology," referring to the effect of heat on the formation of coal, says, with reference to the assumed climate of the coal period:—

"So long as the botanist taught that a tropical climate was implied by the carboniferous flora, geologists might well be at a loss to reconcile the preservation of so much vegetable matter with a high temperature; for heat hastens the decomposi-

tion of fallen leaves and trunks of trees, whether in the atmosphere or in water. It is well known that peat, so abundant in the bogs of high latitudes, ceases to grow in the swamps of warmer regions."

This question of British climate at the coal period is a vexed one, even amongst geologists; as Sir Charles Lyell says, "It seems, however, to have become a more and more received opinion that the coal plants do not, on the whole, indicate a climate resembling that now enjoyed in the equatorial zone."* Whereas Professor H. W. Bristow, F.G.S., says of the climate necessary to the coal period, "Continual rains and intense heat, a soft light, veiled by permanent fogs, were favourable to the growth of this peculiar vegetation, of which we search in vain for anything strictly analogous in our own day."† As this is a question of theory, and not of fact—one requiring only sound reasoning faculties—we ask our intelligent readers to imagine a dense, growing forest of the coal period. The earth at that time must have had much the same constituents forming its atmosphere as at present, as the remains of grasshoppers, crickets, scorpions, fishes, reptiles, shellfish, &c., have been found; which goes to prove that the vegetable kingdom of the primary coal period required for its growth the same atmospheric gases

* "Elements of Geology," p. 501.

† "World before the Deluge," p. 135.

which now constitute its principle of vitality. And, as raindrops have been stamped on the sandstone pages in the book of Old Time, we are therefore warranted in assuming that the atmosphere of the carboniferous period was much the same as in our own days.

We may, then, reasonably inquire, why should not the laws which govern vegetable decay have been in force as well at the period of the coal formation as they are now? Thus, if the gigantic Ferns, Calamites, Sigillaria, Lepidodendron, Neuropteres, Odontopteres*—together with the smaller family of the cryptogamous plants comprised in the mosses, lichens, and fungi—grew and fell *in situ*, what preservative power could they have possessed against the ever-consuming action of the oxygen of the air, as compared with a tree or plant at the present period, which, on its fall, gradually decays, and its earthy matter resolves into vegetable mould? As decay progressed, its hydro-carbon, oxygen, and nitrogen would be gradually dissipated in the air; and hence arises the inquiry, will vegetable mould make coal? No. Sir Charles Lyell says:—

"In South Wales the coal measures have been

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* Professor Bristow says that many coal-mines "contain no vestiges of the great trees of the period, but only of fern and other herbaceous plants of small size."

ascertained by actual measurement to attain the extraordinary thickness of 12,000 feet; the beds throughout, with the exception of the coal itself, appearing to have been formed in water of moderate depth, during a slow, but perhaps intermittent, depression of the ground, in a region to which rivers were bringing a never-failing supply of muddy sediment and sand. The same area was sometimes covered with vast forests, such as we see in the deltas of great rivers in warm climates, which are liable to be submerged beneath fresh or salt water, should the ground sink vertically a few feet.

"They are said to form the floor on which the coal rests, and some of them have a slight admixture of carbonaceous matter, while others are quite blackened by it. All of them, as Sir William Logan pointed out, are characterized by inclosing a peculiar species of fossil vegetable called *stigmaria*, to the exclusion of other plants. It was also observed that while, in the overlying shales or "roof" of the coal, ferns and trunks of trees abound without any *stigmariæ*, and are flattened and compressed, those singular plants of the under-clay very often retain their natural forms, branching freely, and sending out their slender, leaf-like rootlets, formerly thought to be leaves, through the mud in all directions.

"Several species of *stigmariæ* had long been

known to botanists, and described by them, before their position under each seam of coal was pointed out, and before their true nature as the roots of trees was recognized. It was conjectured that they might be aquatic, perhaps floating plants, which sometimes extended their branches and leaves freely in fluid mud, and which were finally enveloped in the same mud."

If it is contended that such plants as those of the carboniferous period grew in the muddy water of deep bays, swamps, and estuaries, and that when they fell from decay they became submerged, and thus preserved their gaseous matter,—we reply that this theory will not hold, as, in the first place, only cryptogamous plants would grow with their roots immersed in water for long periods; they would die from drowning. Even the tropical mangrove-trees of the muddy shores of India preserve a strict line of demarcation to the area of low tides, beyond which not a foot seaward will they grow, while landwards, at the limits of high tides, equally mark their farthest extension. On the other hand, a coal-bed thus formed would, from the action of spring tides, deposit silt, and thus contain as much clay, sand, or other fluviatile matter as of carboniferous mineral. Yet the most remarkable feature of coal lies in its freedom from foreign matter. But were this the right solution of the formation of the

primal coal-beds, why should the same action not be in course of operation at the present day? We have the same undisturbed natural decay of vegetable matter in many parts of the world, but we find no trace of gradually progressive coal formation.

Let us imagine a thick, full-grown forest of the coal period slowly undergoing the process of submergence. Would it go down "all standing," as a sailor would term it, or slowly? In either case (except its submergment were sudden) the upper trunks and branches would die and decay, from the roots of the trees being cut off from air. Even if we admit the possibility of the wood preserving its carbonaceous vitality, yet each tree-bole and plant would be enveloped in a matrix of the soil it grew on, and thus mar its purity from foreign matter. Turn which way we may, we meet with insuperable difficulties antagonistic to the adoption of the doctrine of submergence. For instance, let us suppose that the whole fibrous contents of a forest subsided in a compact prostrate form, and ready to be converted into coal by subterranean heat and pressure; its thickness would only be seven-hundredths of the volume of the original wood. In the ideal pictures of the supposed sole source of the coal vegetation, as given in the illustrations of geological books, the roots are immersed in water; and as some of these forests must have grown in or on river-banks, bays, or

estuaries of the ocean, to admit of the intercalary cappings of sandstone shale, and other sedimentary matter, such carboniferous sites would also admit marine vegetable matter—the timber-drift of the ocean, and thus support our views on coal formations. It is also favourably significant of our theory, that only one land shell has yet been found in coal measures, although many marine remains, fishes, and other vertebrated animals have been discovered.

In writing of a coal seam near Pottsville, on the Mississippi, Sir C. Lyell alludes to broken *stigmaria* found beneath the anthracite. But there are many instances of sigillaria being broken off, leaving their roots covered by a foreign vegetation. Therefore, the fact of stigmaria being found *in situ* beneath this mass of coal, may be used against the assumption that the vegetation requisite to form such a vast thickness of anthracitic coal grew on the spot. May drift-timber not have been deposited over the stigmaria? And is not the very fact of the accompanying layer of "pebbles of quartz, the size of a hen's egg," a certain indication of severe and unusual fluviatile commotion?

Such succession of coal seams may be more reasonably accounted for by successive deluges, bearing timber-drift in varying quantities during their long periods of intermission; for when one of these did occur, with its attendant icebergs, it would be

no improbable circumstance for a sea of rifted timber to be impelled onward in high swathes, on the angry crests of gigantic waves of translation, when entering a bay, estuary, sound, or large river-mouth, and finally deposited in high-piled ridges 300 feet in altitude, be finally jammed against the coast in one long even layer, and detained there by stranded icebergs until the rift became water-logged and sank to the bottom, the same as we pick submerged sticks from a pond, which sink like a stone when again cast into the water.

In such a case, clay, sand, and pebbles would, from their greater specific gravity, have sunk beneath the timber; but the soil of the submergists must go down as an envelope with the plants it nourished. There is no escape from this. What, then, are we to infer from the nearly entire absence of impure matter in coal? According to the submerging theory, the land must have sunk, not once, but dozens of times, to admit of the usual superimposed deposit of fluviatile stratified earths above the vegetable matter carried down.

With regard to the swamps in which this impossible timber is believed to have grown, why should they have always subsided in the carboniferous period? Whereas, under our modern visible observations, swamps invariably become filled up and raised above the swamp condition. Cryptogamous

plants may grow and become submerged in a deep swamp, and the vegetable fibre retain its carbonaceous principle, but it produces bog-turf only, for we have no certain knowledge of turf being metamorphosed into bituminous coal. We cannot believe that large forest-trees (even if they could vegetate in a half-submerged swamp, such as pictured in the books of some geologists) would grow and decay into vegetable mould, and successive forests (Phoenix-like) rise from their decay, as there would only be the light and friable vegetable mould wherein to fix the roots of the various successive superimposed growths, to enable them to withstand storms. Let us, therefore, inquire into the great mystery which, to our mind, has ever invested the formation of the coal measures, as accounted for by the reasoning of the "submergists."

In page 69 a quotation is given from Sir Charles Lyell's "Elements of Geology" on the climate of the coal period, wherein he says, "Heat hastens the decomposition of fallen leaves and trunks of trees, whether in the atmosphere or in water. It is well known that peat, so abundant in the high latitudes, ceases to grow in the swamps or warmer regions." After this honest and, let us add, truthful, confession, we may be permitted again to inquire, by what process of natural means can he demonstrate the formation of coal from vegetable matter grown

in situ? For we have the coal-fields of Burdwan, in the intensely hot valley of the Ganges; as well as at Wurdah, one of the head-water tributaries of the Godavery; and in the equally hot climate of the newly-discovered coal-field on the east bank of the Hasdo River, a tributary of the Great Mahanuddee, on the Coromandel Coast of India; together with the coal formations on the banks of the Nerbudda, in Central India, but which was then an island cut off from the Continent by the two great water-sheds of the Punjaub River system, and that of the Gangetic Valley. Then we have coal-fields in the equally hot climate of Borneo and Labuan (latitude 3° 20′ N.), in the Malayan Archipelago. Newcastle (New South Wales) has a somewhat similar climate, yet has she abundance of the finest coal seams at various depths. Yet the West Coast of Australia is clothed with an impenetrable growth of marsh vegetation accompanied with a climate greatly resembling the most fittest for the growth of coal, as quoted* by Professor Bristow, F.G.S. Yet no coal has been found hitherto in that vast island-continent, save in New South Wales, if we except the unworkable driblets possessed by the colony of Victoria on the one hand, and Queensland on the other; the latter having the best of her "driblets" well up in the

* "World before the Deluge," p. 68.

North, where the climate assumes a tropical character, and where the boulder-drift—that significant accompaniment of coal formations—is most apparent. Yet the climate of Victoria assimilates closer to that of the great coal regions of Britain, and her forests are of denser growth than in any other part of Australia. Nevertheless, she is all but coal-less, whilst her boundary neighbour, New South Wales, is gifted to repletion with the precious carbonaceous mineral.

If, then, coal formations are alone due to what we must call the impossible doctrine of the submergence of vegetable matter grown *in situ*, why are so many well-timbered countries in the world denied it? Here we find opposite opinions from two illustrious geologists, as to the assumed climates proper to the coal period, yet both are at variance with the existing facts just given.

If we are to be confined to the defective theory of the submergists, it will be interesting to show how exceptionally capricious Nature has been in manufacturing coal from vegetable matter grown *in situ*. We have already glanced at the barrenness of the coal-gift to the colonies of Victoria and Queensland, on either side of New South Wales; whilst the latter has been endowed with the precious mineral in inexhaustible profusion, both in the bituminous richness of the coal and also in shales so pure that they

will burn like a candle. The chief sites of deposit are at Newcastle (N.S.W.) on the Hunter River, eighty miles north of Sydney, where they run for twenty miles parallel with its banks, and beneath its bed, having five seams—one of them 30 feet thick—over a large area. When we approach its mouth, there are three thick seams running eighty miles south towards the capital. One seam is in the side of the coast-line range of densely wooded hills; the next is from 120 to 136 feet deep; whilst the third, richest, and deepest, is 365 feet below the surface. On the south of Sydney, the coal measures extend sixty miles, to the Bellami and Wollongong mines, but which are of inferior quality.*

The voyager, when steaming close along the picturesque coast where the two latter are situated, can see the central seam, which here rises to near the surface, and crops out just above sea level on the face of the sandstone cliffs which form the coast-line.

In trying to reconcile these marked departures from the otherwise consistent courses of Nature, even the gifted Lyell is sometimes betrayed into advancing false deductions in accounting for these vagaries, when, in favour of the submerging theory, he says ("Elements of Geology," p. 489) :—

* The Author has visited the mines on the Hunter, and gone down them.

"The delta of the Ganges presents, in one respect, a striking parallel to the Nova Scotia coal-field; since at Calcutta, at the depth of eight or ten feet from the surface, the buried stools of trees, with their roots attached, have been found in digging tanks, indicating an ancient soil, now underground; and in boring on the same site for an artesian well, to the depth of 481 feet, other signs of ancient forest-covered lands and peaty soils have been observed at several depths, even as far down as 300 feet and more below the level of the sea."

We would now ask, in all fairness of argument, why this vegetable matter was not also converted into coal, as in other submerged cases? and also, why coal has not been formed in the 30,000 square miles of the Gangetic delta, with its three great streams, the Jumna, Hoogly, and Ganges, each of which must have had, in antediluvial ages, a redundant forest growth along its whole course? Should not Nature have been consistent, and have formed coal-beds from the vegetable *debris* thus submerged as well as in Great Britain, North America, or on the comparatively puny banks of the Hunter?

There is certainly a limited coal-field at Burdwan, and the mineral has also been found on the banks of the Upper Nerbudda Valley and the other places already named, on the Coromandel Coast; but although coal is in such demand all over the sea-

board of India, and human labour can be had at threepence a-day, yet Calcutta, Bombay, and Madras draw their supplies from Great Britain and Sydney. The Burdwan seam is 9 feet thick 90 feet below the surface; its quality is about the same quality as the inferior Australasian coal of the tertiary deposit,* and is used at the inland stations of the East Indian Railway. Perhaps these formations are due, either to the Asiatic flood or to the vast aqueous disturbance which would ensue from the alternate deluge-waves from the Antarctic pole, at a period when the present delta of the Ganges was an estuary 600 miles nearer to its source, and those of the Godavery and Mahanuddee were nearly a similar distance back from their present mouths. The same strange absence of mineral fuel apply to the valleys of the Euphrates, Indus (3,000 miles long), Myhie, Taptee, Upper Ganges (of India), Negrais, Irawadi, Sittan, and Cambogia (of Pegu), Burmah, and Anam (all with immense forests). Whilst on the South-east Coast of South America, there are vast forest-lands drained by the Rio de Plata and its affluent, the Rio Negro; to which we may add the Nile and the whole of the continent it belongs to; besides all Northern Asia (except its polar coast), including the large countries it embraces, such as Afghanistan,

* This remark does not apply to the excellent bituminous coal of Newcastle, New South Wales.

Arabia, Persia, and Northern India; whilst Ceylon, Siam,* Cambodia, the Philippine Islands, and Eastern Archipelago, are equally bare of coal, except Borneo Proper and Labuan, which possess coal on their north sides, facing Behring's Straits; as do also China. The Island of Formosa and Japan have also coal measures, but on their northern parts only.

Most of the countries named we have visited—in many of them travelled extensively—and can vouch for their redundant growth of vegetation, which in some parts is so dense as to awe and repel man on his path of civilization.

The various Pachas of Egypt have spared no expense in the search for coal, and would largely reward any fortunate finder.

That extensive south-east coast-line of South America, having the huge basins of the Rio Plata and Rio Negro, with other large rivers, extending from Cape St. Roque to Cape Horn, is quite destitute of coal. But directly we round the Horn, and get on the South-west Coast of Patagonia, we come upon tertiary beds of lignite, similar to those of New Zealand and Tasmania. The south side of the Isthmus may have been, with a great degree of probability, an extended estuary in the coal period,

* We should, however, be prepared for the discovery of coal in the regions of Burmah, Siam, Anam, and Cambodia.

which would lie right open to the Antarctic polar-drift, as does the whole of the West Coast of North and South America. The coal formation at the Isthmus itself extends over a large area, as we learn from Mr. Wheeler, who in 1841 was employed to search for coal by the Pacific Steam Navigation Company. He says that a canal can be cut across from Boca del Toro, on the Atlantic, to Cherokee, on the Pacific; the whole distance of forty miles being through coal, with an excellent harbour at each end.

Before we quit the south-west sea-board of the South American Coast, we would direct attention to the tertiary deposit of brown coal,* which extends nearly uninterruptedly from near Mexico, following the eastern flank of the Rocky Mountains, up to the Polar Sea; thus occupying thirty-five degrees of latitude, or nearly 2,500 miles, following its oblong range; and has a maximum breadth at N. latitude 48 of 400 miles; the whole area computed at 250,000 square miles, or 160,000,000 of acres—more than twice the size of Great Britain! Yet there is not an ounce of coal on the superior floral

* In this tertiary deposit New Zealand and Tasmania share. There has, however, quite recently been discovered extensive beds of good bituminous coal on the extreme south of the MIDDLE ISLAND, exactly open to the South Polar drift.

redundancy on the neighbouring south-east coast —so favourable for growth *in situ !*

From partial explorations, it is nearly certain that coal of the same formation may be found westerly from Mackenzie's River to the Icy Cape, by Point Barrow, and into Behring's Strait, along the north coast of Russian America; thus giving twenty degrees more to the thirty-five previously mentioned. Turning to the southward, towards Cape Horn, after an uncertain interval of twenty-five degrees, we find ourselves on the same brown coal strata which extend more or less along the Pacific side of the northern Mexican provinces, from the Isthmus of Tehuantepec to that of Panama; and then, with a few interruptions, continuing all down the western side of South America to the equinoctial line; thence on to Lima, with other interruptions more or less, up to and beyond Patagonia, 50 S. latitude; thus forming two *contemporaneous belts,* 2,500 miles long each, extending through both continents to points at least 120 degrees asunder—namely, the Frozen Sea or Icy Cape to the North (the mammaliferous bone-heap of the deluges), and to Southern Patagonia to the South.

We here freely appeal to the inductive reasoning of our readers in favour of the deluge theory of M. Adhemar, as by none other than fluviatile agency could such a vast coal formation be laid down, and

the vegetable matter to form it could not have been other than a vast denuding and transporting force to effect it. As we shall have, further on, equally or even more striking evidence of the deluge drift action, we would ask our readers' special attention to the numerous striking instances of its application.

Thus the deluge drift from the South Pole would supply the Pacific coast-line of North and South America; whilst the North Polar alternate deluge drift would rush down Baffin's Bay through Davis's Straits, where, meeting the flood down the east coast of Greenland off Cape Farewell, its timber-laden waters would be impelled on to the coast of Newfoundland, on through the Straits of Bellisle into the crescent-shaped Gulf of St. Lawrence, whilst a large portion would be hurried down the North Atlantic into the Gulf of Mexico, on to the Isthmus of Panama, and thence extending to the then open basin of the sea-like Amazon.

At the same time, the roaring waters of the mighty deluge flood would be stripping the forest shores of Asiatic Russia, Nova Zembla, Lapland, Norway, and Denmark, pouring the floral spoil into the then estuary, now the North Sea, distributing its carbonaceous fuel in the great coal basin of the Firth of Forth of Scotland; and those of Durham and the Tees on the south of the Cheviots; in the

south-west, those of Somersetshire and Gloucestershire, in which two latter there is alone sufficient coal for one hundred years to meet the annual consumption of Great Britain at the rate of 100,000,000 tons per annum. Further south we have the great coal-fields of the "BLACK COUNTRY," with Derby, Wolverhampton, Birmingham, Sheffield, Stockton, Leeds, and Manchester, as its great central landmarks.

Nothwithstanding this wealth of mineral fuel, Sweden, Norway, and Denmark being probably without deposit basins at the coal period for the reception of the North Polar fluviatile timber-rush, have not received an ounce of vegetable fuel, although "within hail," as it were, of the Britain or the coal period. With nearly a similar climate, and redundant forests, why did Nature niggardly halt in the bestowal of carboniferous gifts to those countries when she poured them into the then large open bays of Britain, with such profuse abundance?

Let us not lose sight of our chief and only object, which is to draw deductive inferences as to the carboniferous deposits being brought about by the direct agency of the assumed periodical deluges. To understand and appreciate the immensely vast action of these, and their causes, one must first read Adhemar's treatment of the subject.

Thus prepared, let any intelligent reader glance

at a Mercator's map, and he will at once observe the channel opening from the North Polar Sea, through Behring's Straits and along the Sea of Kampschatka, as the probable channel for icebergs, and the vegetable deluge drift, forming the source of the coal-fields of the northern regions of Japan, China, the island of Formosa and Borneo Proper, together with its island neighbour, Labuan (thirty miles distant), remarkable as the only spots where a discovery of coal has yet been made amongst that singularly broken-up island group comprised in the Eastern Archipelago. Was this group a coeval ruin with that of the South Pacific island groups, and due to the same cause as the present disjected line of islands? All have foundations of coral, with connecting reefs of the same formation, hundreds of miles long, which would lead us to suppose that they once not only formed a continent, which embraced New Guinea as its terminal point, but also the whole of the present Malayan Peninsula.

Having briefly noticed the strange absence of coal deposits in the greater portion of the eastern, and other parts of the world, where we should naturally expect to find the richest deposits, if the carboniferous mineral were derived solely from vegetable growth *in situ*, and the strangely exceptionable presence of coal in New South Wales and the south-west coast of South America, as well as on the

southern parts of New Zealand and Tasmania, we will now turn our attention to the northern hemisphere, where an equally strange yet significant phenomenon reveals itself, in the fact that the farther north we go, the more profuse stores of fuel do we find, even up to the shores of the Icy Sea, where the beach-worn coal is picked up on the shore.

Melville Island, and its great surrounding group, is abundantly furnished with the precious mineral; whilst in warmer climates, with immense estuaries and river valleys thousands of miles long, the shores matted with an impenetrable flora, the carboniferous gift is denied. We cannot reconcile these conflicting facts with the order of Nature. But when we apply the theory of fluvial drift forces of periodical deluges, alternately from north to south, the hidden mist of doubt rises, and reveals everything that before was a contradictory mystery repugnant to reason.

When we reflect on the immense beds of coal formed on the shores of Newfoundland, Cape Breton, Nova Scotia, New Brunswick, and Prince Edward's Island—nearly all on the crescent-shaped shores of the Gulf of St. Lawrence, directly open to receive the North Polar drift—we are lost in astonishment at their extent and depth. Newfoundland alone has beds 200 miles long, embracing a car-

boniferous area of 5,000 square miles. Yet these are eclipsed by the coal-fields of New Brunswick, which alone has an area of 8,000 square miles, some of the seams being 40 feet thick. Her British sister, Nova Scotia, has an area of 5,000 square miles. The coal measures just described do not embrace those of the St. Lawrence and numerous other mines in British America.

The States of America are equally well provided in their prodigious coal-fields, the names only of which would fill this page; one division alone (the Illinois) *has* 30,000 *square miles of coal formation!* By a glance at the map, we cannot but conclude that the Gulf of St. Lawrence and the Gulf of Mexico, leading to what were probably then estuaries of the river systems of the St. Lawrence and Mississippi—extending far back towards their sources—determined by the primitive hills which were then already formed and thus served as huge depositary basins for the coal measures which now served the wants of that great country.

This universal feature of primitive hills and mountains, determining the outline boundaries of our coal-fields, with due allowance made for denuding influences, all tell in favour of the "drift" as the agent in furnishing the main deposits of carboniferous mineral.

Geologists appear to be generally silent as to the

fact that the great coal-fields of the world are generally found in what we know (or have strong reason to believe) were estuaries, bays, or large river-mouths, in the coal periods; yet they pretty well all agree in claiming the low-lying swamps as the sites for the growth of the then future coal-fields, on the submergent principle. It would, therefore, be quite in keeping to suppose that such sites would be equally the open depositaries for the deluge timber-drifts. We must not omit to mention that the whole area comprising the West India Islands, including Cuba, appears to have formed a vast coal-field, the carbonaceous matter since altered, by metamorphic action, into every variety of mineral oil, including mineral caoutchouc, compact bitumen or asphaltum, mineral pitch, and mineral oil (the Seneca, or Genesee, oil of the United States). All these varieties exist in Cuba alone, and no doubt owe their existence to subterranean heat, as mica slates and other metamorphic rocks are found with the oil piercing through them; and in many places in the neighbourhood of Havana petroleum springs are abundant. The pitch lake of Trinidad is, without doubt, due to the still forces of volcanic action, as it occupies the highest land in the island, also some of its more elevated parts are covered with scoria; and it is highly probable that solid anthracitic coal

has been somewhat similarly altered by distillative or other metamorphic action, in common with all the mineral oil varieties. One mine of asphaltum near Havana has been bored down to fifty-five yards (165 feet), all in the same mineral, and not then bottomed!

The period at which the deluge drift was furnishing matter for our future coal-beds in the Durham, Yorkshire, and other basins, the Straits of Dover were not then open; Holland was buried in the womb of Time; whilst Belgium and the North of France were under the sea. Here, again, our views regarding the "drift" theory are favoured by what are now the Straits of Dover being closed. The result? Sir Roderick Murchison says that "productive coal measures could not be looked for in Essex, Kent, Sussex, Middlesex, Hants, Bucks, Oxfordshire, Suffolk, Norfolk, &c." Here we have deductive proof that these counties, from their southern position, having been cut off from sharing the deluge drift from the Arctic Pole, are without bituminous fuel. On the other hand, being situated in a more genial climate than could have existed in the carboniferous northern districts of Britain, and if vegetable fuel be alone due to growth and submergence *in situ*, it is very singular that so many as nine southern counties, the names of which we have given above, with a milder climate, should be without it.

As to sufficiency of coal, Mr. Hull, a high authority, says, "As regards the absolute quantity of mineral fuel in this island (England), it may be considered as practically inexhaustible; the seams of coal outcrop in our coal-fields, and descend under the Permian and Triassic formations to depths exceeding 10,000 feet. The question of the available supply is, therefore, one dependent on the rapidity of production and the limit of depth." With regard to the latter difficulty, this probably may be obviated by some such chemical means for keeping mines cool as the freezing process lately adopted for preserving fresh meat. It is also treated as a certainty that coal-mines exist under the North Sea. Here we have evidence of, not submergence, but, on the contrary, succeeding strata, like "Pelion on Ossa piled," by the vast levelling and erosive power of hurricanes and of its accompanying dread deluge —rushing from either pole alternately, stripping forests from the land, and raking up the floors of what are now deep seas to add layer by layer to the stratified series of the polar hemispheres.

We have only space to glance at the coal measures of Ireland and Wales, the former possessing coal in seventeen counties, the principal being those of Leinster and Munster, carbonaceous, or stone coal; Connaught and Ulster, bituminous, or blazing coal. The Welsh coal, famous for its good steam-

raising qualities, extends more or less over the whole of South Wales; some of the coal measures being 12,000 feet in depth, with the best qualities of ironstone on the coal floors of the bottom strata.

Sir Roderick Murchison is of opinion that Ireland, Anglesea, and the Isle of Man, together with England and France, have, at a time not very distant, been joined together; the great Irish elk having been found in the bogs of Ireland, as well as in Cheshire and the Isle of Man. By a reference to the map, it will be seen that, as in nearly every case, the great coal deposits are found in the former extended basins of what is now the British Channel on the south-west, whilst on the north-west the Mersey Channel fed the basin of Newcastle-under-Lyne.

Thus, if we assume that St. David's Head, on the Welsh Coast, was joined to Carnsore Point, in Ireland, we have the key to the coal formations of Ireland and Wales, by the alternate South and North deluge drifts; the former by (what is now) the North Irish Channel, and the other by the South Channel, terminating in the basin of Merthyr Tydfil, Gloucester, and other coal measures of the Severn basin.

What other fluviatile agency, except the mighty force set in action by the swift waters of a deluge, alternately, from either pole, would satisfactorily ac-

count for such dread phenomena as we have elsewhere related? The bare fact of mammaliferous remains of the pachyderms found in North Siberia in a conglomerate of ice, sand, and mud, we consider, should to all reasoning minds, be indubitable evidence of deluge action. In connexion with astronomical signs, we may expect the next deluge from the South Pole.

We close this book by giving a short account of the Deluge dates put forward by various nations and authors of the same. We also think that the day will arrive when the great Gizeh Pyramid will be found to have been built as a warning guide to man. The Deluge was threatened in the year of the Hebrew world 1536, and began December 7th, 1656, and continued 377 days. The Ark rested on Mount Ararat, May 6th, 1657; and Noah left the Ark December 18 following. The year corresponds with that of 2348 B.C. (Blair). The following are the epochs of the Deluge according to Dr. Hales :—

1. Septuagint,	B.C.	3246	Adhemar, B.C...		2330
			,,	less by	916
2. Jackson ...	,,	3170	,,	,,	840
3. Hales... ...	,,	3155	,,	,,	825
4. Josephus ...	,,	3146	,,	,,	816
5. Persian ...	,,	3103	,,	,,	773
6. Hindoo ...	,,	3102	,,	,,	772

7. Samaritan...	B.C.	2998	Adhemar,	less by	668
8. Howard ...	„	2698	„	„	368
9. Playfair ...	„	2352	„	„	62
10. Usher ...	„	2348	„	„	18
11. English Bible	„				
12. Marsham ...	„	2344	„	„	14
13. Petavius ...	„	2329	„	excess by	1
14. Strauchius	„	2293	„	„	37
15. Hebrew ...	„	2288	„	„	42
16. Vulgar Jewish	„	2104	„	„	226

If the above dates of the various alleged periods of the last Deluge be compared with Adhemar's, it will be seen that while the latter places the event at 2,330 years B.C., reckoning from 1870, there are several of the former approaching to what may be called equal dates.

In the reign of Ogyges, King of Attica, 1764 B.C., a deluge so inundated Attica that it lay waste for nearly 200 years (Blair). Buffon thinks that the Hebrew and Grecian deluges were the same, and arose from the Atlantic and Bosphorus bursting into the valley of the Mediterranean.* The fabulous deluge of Deucalion is placed 1503 B.C., according to Eusebius. It was often confounded by the ancients with the general flood; but it was 845

* A general deluge was predicted to occur in A.D. 1524, and arks were built; but the season happened to be a fine and dry one.

years posterior to that event, and was merely a local inundation, occasioned by the overflowing of the River Pineus, whose course was stopped by an earthquake between the Mounts Olympus and Ossa. Deucalion, who then reigned in Thessaly with his wife Pyrrha, and some of their subjects, saved themselves by climbing Mount Parnassus.

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