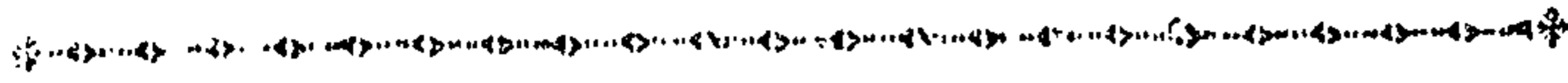


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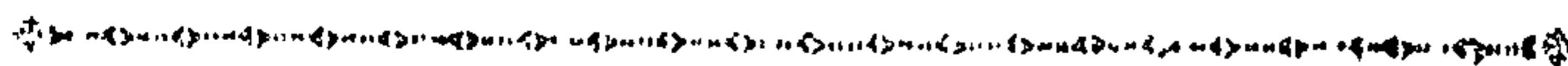
SEVENTH OF MARCH, AND FOURTH OF APRIL,

M, DCC, LXXXV,

C O N C E R N I N G T H E

S Y S T E M O F T H E E A R T H,

I T S D U R A T I O N, A N D S T A B I L I T Y.



*Dr Lind Winder
from James Hutton*

ABSTRACT, &c.

TH E purpose of this Dissertation is to form some estimate with regard to the time the globe of this Earth has existed, as a world maintaining plants and animals ; to reason with regard to the changes which the earth has undergone ; and to see how far an end or termination to this system of things may be perceived, from the consideration of
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that which has already come to pass.

As it is not in human record, but in natural history, that we are to look for the means of ascertaining what has already been, it is here proposed to examine the appearances of the earth, in order to be informed of operations which have been transacted in time past. It is thus that, from principles of natural philosophy, we may arrive at some knowledge of order and system in the oeconomy of this globe, and may form a rational opinion with regard to the course of nature, or to events which are in time to happen.

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The solid parts of the present land appear, in general, to have been composed of the productions of the sea, and of other materials similar to those now found upon the shores. Hence we find reason to conclude,

1st, That the land on which we rest is not simple and original, but that it is a composition, and had been formed by the operation of second causes.

2^{dly}, That, before the present land was made, there had subsisted a world composed of sea and land, in which were tides and currents, with such operations at the

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the bottom of the sea as now take place. And,

Lastly, That, while the present land was forming at the bottom of the ocean, the former land maintained plants and animals; at least, the sea was then inhabited by animals, in a similar manner as it is at present.

Hence we are led to conclude, that the greater part of our land, if not the whole, had been produced by operations natural to this globe; but that, in order to make this land a permanent body, resisting the operations of the waters, two things had been required;

red ; 1st, The * consolidation of masses formed by collections of loose or incoherent materials ; 2^{dly}, The elevation of those consolidated masses from the bottom of the sea, the place where they were collected, to the stations in which they now remain above the level of the ocean.

Here are two different changes, which may serve mutually to
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* There are two senses in which the term *solidity* is used ; one of these is in opposition to *fluidity*, the other to *vacuity*. When the change from a fluid state to that of solidity, in the first sense, is to be expressed, we shall employ the term *concretion* ; consequently, the consolidation of a mass is only to be understood as in opposition to its vacuity, or porousness.

throw some light upon each other; for, as the same subject has been made to undergo both these changes, and as it is from the examination of this subject that we are to learn the nature of those events, the knowledge of the one may lead us to some understanding of the other.

Thus the subject is considered as naturally divided into two branches, to be separately examined: *First*, by what natural operation strata of loose materials had been formed into solid masses; *secondly*, By what power of nature the consolidated strata at
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far the power of this solvent, acting in the natural situation of those strata, might be sufficient to produce the effect; and here it is found, that water alone, without any other agent, cannot be supposed capable of inducing solidity among the materials of strata in that situation. It is, *2dly*, considered, how far, supposing water capable of consolidating the strata in that situation, it might be concluded, from examining natural appearances, that this had been actually the case? Here again, having proceeded upon this principle, that water could only consolidate strata with such substances as it has the power to dissolve,

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and having found strata consolidated with every species of substance, it is concluded, that strata in general have not been consolidated by means of aqueous solution.

With regard to the other probable means, heat and fusion, these are found to be perfectly competent for producing the end in view, as every kind of substance may by heat be rendered soft, or brought into fusion, and as strata are actually found consolidated with every different species of substance.

A more particular discussion is then entered into: Here, consolidating substances are considered as being classed under two different heads, viz. Siliceous and sulphureous bodies, with a view to prove, that it could not be by means of aqueous solution that strata had been consolidated with those particular substances, but that their consolidation had been accomplished by means of heat and fusion.

Sal Gem, as a substance soluble in water, is next considered; in order to show that this body had been left in a melted state; and this example is confirmed by one of
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of fossile alkali. The case of particular sectaria of iron-stone, as well as certain crystallized cavities in mineral bodies, are then given as examples of a similar fact; and as containing, in themselves, a demonstration, that all the various mineral substances had been con-creted and crystallized immediately from a state of fusion.

Having thus proved the actual fusion of the substances with which strata had been consolidated, in having such fluid bodies introduced among their interstices, the case of strata, consolidated by means of the simple fusion of their proper materials, is next considered ;

ed; and examples are taken from the most general strata of the globe, viz. siliceous and calcareous. Here also demonstration is given, that this consolidating operation had been performed by means of fusion.

Having come to this general conclusion, that heat and fusion, not aqueous solution, had preceded the consolidation of the loose materials collected at the bottom of the sea, those consolidated strata, in general, are next examined, in order to discover other appearances, by which the doctrine may be either confirmed or refuted. Here the changes of strata, from
their

their natural state of continuity, by veins and fissures, are considered; and the clearest evidence is hence deduced, that the strata have been consolidated by means of fusion, and not by aqueous solution; for, not only are strata in general found intersected with veins and cutters, an appearance inconsistent with their having been consolidated simply by previous solution; but, in proportion as strata are more or less consolidated, they are found with the proper corresponding appearances of veins and fissures.

With regard to the second branch, in considering by what
power

power the consolidated strata had been transformed into land, or raised above the level of the sea, it is supposed that the same power of extreme heat, by which every different mineral substance had been brought into a melted state, might be capable of producing an expansive force, sufficient for elevating the land, from the bottom of the ocean, to the place it now occupies above the surface of the sea. Here we are again referred to nature, in examining how far the strata, formed by successive sediments or accumulations deposited at the bottom of the sea, are to be found in that regular state, which would necessarily take place
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and to resist the violent efforts of the ocean.

This theory is next confirmed by the examination of mineral veins, those great fissures of the earth, which contain matter perfectly foreign to the strata they traverse; matter evidently derived from the mineral region, that is, from the place where the active power of fire, and the expansive force of heat, reside.

Such being considered as the operations of the mineral region, we are hence directed to look for the manifestation of this power and force, in the appearances of
nature.

nature. It is here we find eruptions of ignited matter from the scattered volcano's of the globe; and these we conclude to be the effects of such a power precisely as that about which we now inquire. Volcano's are thus considered as the proper discharges of a superfluous or redundant power; not as things accidental in the course of nature, but as useful for the safety of mankind; and as forming a natural ingredient in the constitution of the globe.

The doctrine is then confirmed, by examining this earth, and by finding every where, beside the many marks of ancient volcano's;

cano's, abundance of subterraneous or unerupted lava, in the basaltic rocks, the Swedish trap, the toadstone, ragstone, and whinstone of Britain and Ireland, of which particular examples are cited; and a description given of the three different shapes in which that unerupted lava is found.

The peculiar nature of this subterraneous lava is then examined; and a clear distinction is formed between this basaltic rock and the common volcanic lavas.

Lastly, The extension of this theory, respecting mineral strata, to all parts of the globe, is made,
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by finding a perfect similitude in the solid land through all the earth, although, in particular places, it is attended with peculiar productions, with which the present inquiry is not concerned.

A theory is thus formed, with regard to a mineral system. In this system, hard and solid bodies are to be formed from soft bodies, from loose or incoherent materials, collected together at the bottom of the sea; and the bottom of the ocean is to be made to change its place with relation to the centre of the earth, to be formed into land above the level
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of the sea, and to become a country fertile and inhabited.

That there is nothing visionary in this theory, appears from its having been rationally deduced from natural events, from things which have already happened ; things which have left, in the particular constitutions of bodies, proper traces of the manner of their production ; and things which may be examined with all the accuracy, or reasoned upon with all the light, that science can afford. As it is only by employing science in this manner, that philosophy enlightens man with the knowledge of that wisdom or
design

design which is to be found in nature, the system now proposed, from unquestionable principles, will claim the attention of scientific men, and may be admitted in our speculations with regard to the works of nature, notwithstanding many steps in the progress may remain unknown.

By thus proceeding upon investigated principles, we are led to conclude, that, if this part of the earth which we now inhabit had been produced, in the course of time, from the materials of a former earth, we should, in the examination of our land, find data from which to reason, with regard

gard to the nature of that world, which had existed during the period of time in which the present earth was forming; and thus we might be brought to understand the nature of that earth which had preceded this; how far it had been similar to the present, in producing plants and nourishing animals. But this interesting point is perfectly ascertained, by finding abundance of every manner of vegetable production, as well as the several species of marine bodies, in the strata of our earth.

Having thus ascertained a regular system, in which the present land of the globe had been first
formed

formed at the bottom of the ocean, and then raised above the surface of the sea, a question naturally occurs with regard to time; what had been the space of time necessary for accomplishing this great work?

In order to form a judgment concerning this subject, our attention is directed to another progress in the system of the globe, namely, the destruction of the land which had preceded that on which we dwell. Now, for this purpose, we have the actual decay of the present land, a thing constantly transacting in our view, by which to form an estimate.

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This decay is the gradual ablation of our soil, by the floods of rain ; and the attrition of the shores, by the agitation of the waves.

If we could measure the progress of the present land, towards its dissolution by attrition, and its submerfion in the ocean, we might discover the actual duration of a former earth ; an earth which had supported plants and animals, and had fupplied the ocean with thofe materials which the construction of the present earth required ; confequently, we fhould have the meafure of a correfponding fpace of time, viz. that which had been required in the production of the

present

present land. If, on the contrary, no period can be fixed for the duration or destruction of the present earth, from our observations of those natural operations, which, though unmeasurable, admit of no dubiety, we shall be warranted in drawing the following conclusions; *1st*, That it had required an indefinite space of time to have produced the land which now appears; *2^{dly}*, That an equal space had been employed upon the construction of that former land from whence the materials of the present came; *lastly*, That there is presently laying at the bottom of the ocean the foundation of future land, which is to

appear

appear after an indefinite space of time.

But, as there is not in human observation proper means for measuring the waste of land upon the globe, it is hence inferred, that we cannot estimate the duration of what we see at present, nor calculate the period at which it had begun; so that, with respect to human observation, this world has neither a beginning nor an end.

An endeavour is then made to support the theory by an argument of a moral nature, drawn from the consideration of a final cause. Here a comparison is formed

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ed between the present theory, and those by which there is necessarily implied either evil or disorder in natural things ; and an argument is formed, upon the supposed wisdom of nature, for the justness of a theory in which perfect order is to be perceived. For,

According to the theory, a soil, adapted to the growth of plants, is necessarily prepared, and carefully preserved ; and, in the necessary waste of land which is inhabited, the foundation is laid for future continents, in order to support the system of this living world,

Thus,

Thus, either in supposing Nature wise and good, an argument is formed in confirmation of the theory, or, in supposing the theory to be just, an argument may be established for wisdom and benevolence to be perceived in nature. In this manner, there is opened to our view a subject interesting to man who thinks; a subject on which to reason with relation to the system of nature; and one which may afford the human mind both information and entertainment.

