

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW, NEW YORK.

O. D. MUNN.

A. E. BEACH.

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VOL. XXXVII., No. 2. [NEW SERIES.] Thirty-second Year.

NEW YORK, SATURDAY, JULY 14, 1877.

Contents.

(Illustrated articles are marked with an asterisk.)

Africa, carrying peace into.....	16	Gold, dentists' (24).....	27
Air compressor, Bower's.....	18	Horses, dead, standing erect.....	20
Alloy, new.....	15	Inventions patented in England.....	25
American inventions, N. S. Wales.....	25	Lighting, effects of.....	20
American Institute Exhibition.....	24	Lime, precipitating (22).....	27
Answers to correspondents.....	27	Locomotive valves, setting.....	21
Artesian well, pumping (15).....	27	Man's place in Nature.....	25
Billiard ball holder.....	22	Measures of the U. S. (32).....	28
Billiard table.....	23	Mints of the U. S. (30).....	27
Bisulphide of lime (35).....	23	Papier mache (40).....	28
Bleaching silk and wool.....	19	Patents, American and foreign.....	25
Boot and shoe machinery.....	24	Patent decisions, recent.....	25
Bookbinding, new method of.....	19	Patents, official list of.....	25
Books and publications.....	15	Phosphorescent sweating.....	18
Business prospects.....	25	Plague, extension of the.....	24
Carriage crop.....	17	Plants, curious carnivorous.....	23
Catastrophism, Clarence King on.....	16	Popular fallacies.....	24
Catastrophism in geology.....	17	Santini, death of Professor.....	15
Chalkcup.....	22	Sebastin, a new explosive.....	18
Coloring matter from herbs (2).....	19	Skin heat apparatus for utilizing.....	25
Copper plates covered with steel.....	19	Special notices.....	25
Curtain fixture.....	22	Steamer, new.....	21
Disinfecting rooms.....	15	Steam pump, pounding (20).....	27
Duplex education.....	17	Sulphur, test for.....	22
Dyspepsia, on.....	20	Sunstroke.....	20
Education in Germany.....	20	Tin scrap, utilization of.....	19
Electricity, conducting, power (21).....	27	Tin-can telephone.....	21
Electrotyping cylinders (33).....	28	Tin and phosphorus, alloy of.....	21
Electricity and magnetism (5).....	27	Yule, John.....	15

TABLE OF CONTENTS OF THE SCIENTIFIC AMERICAN SUPPLEMENT, No. 80, For the Week ending July 14, 1877.

- I. **ENGINEERING AND MECHANICS.**—Wrought Iron Bridge Designs: by WILLIAM O. DOUGLAS. A method of construction whereby the safety of the structure is not dependent on any single member. 2 engravings.—Steel Wire Ropes: by ALFRED CARPENTER, M.D., C.S.S. A practical experience of the Dry system. Carlin's Bridge, Dublin, 1 engraving.—Extinction of Fires.—Important Dutch Enterprise. Foot Bridge across the River Ness at Inverness; by C. R. MANNERS, Engineer. 13 illustrations. Radiating Steam Hercules for the St. Heliers' Harbor Works, Jersey. 2 figures.—New Method of New Horsehoe.—Scott's Wheel-Cutting and Moulding Machine. 8 figures. Compound Engine with Rope Driving Gear; by BENJAMIN GOODFELLOW, Engineer. 3 engravings.—Differential Screw Pipe Joint. 6 figures. Pipes for Gas and Other Purposes (continued from SUPPLEMENT No. 77). Main-laying continued, with 4 figures.—Fittings of Gas and Water Pipes; includes the average "life" of pipes; an account of various soils, and amount of corrosion in each; Professor Burt's new iron-preserving process, and other processes in practical use for preserving iron pipe; proving pipe; the utility of various metals, and directions for pipe-laying; various fittings, illustrated in 16 figures.
- II. **TECHNOLOGY.**—The Sizing of Cotton Goods; a paper read before the Society of Arts, by W. THOMPSON, F.R.S. A very full and clear description, embracing: An account of the process of weaving, explaining the object and utility of size. A table of sizing mixtures in which are enumerated all the substances used, (1) for giving adhesive properties to the size, (2) to give weight and body to the yarn, (3) for softening the size or yarn, and (4) for preserving the size from mildew and decomposition. Tests for these substances and directions for mixing, so as to obtain the results required. Proportions of sizing. Use of flour in size. Weighting materials, China clay and its substitutes. "Softening" and oils for softening. East winds. Glyceiric, grape sugar, mildew preventives, and tape sizing. "Slashing," packing, mildew, damaged goods, etc.—Notes on Garment Dyeing. Giving preparation of garments with cotton warps, green on garments with cotton warps, brown on the same, etc.
- III. **LIGHT, HEAT, ELECTRICITY, ETC.**—On the Minute Measurements of Modern Science. By ALFRED M. MAYER. Article IX. The dividing engine and methods of making accurate linear scales. 8 illustrations.
- IV. **NATURAL HISTORY, ETC.**—Catastrophism, or the Evolution of Environment. An address by Clarence King before the Sheffield Scientific School of Yale College, New Haven, Conn.
- V. **AGRICULTURE, HORTICULTURE.**—Pencils of Silver Nitrate.—The Black Poplar.—Tree Leaves as a Fertilizer.—Improving Pastures.—Lawns and Hay.—Thoroughbred Pigs.—Shall Country Houses have Cellars?
- VI. **MISCELLANEOUS.**—The New German Patent Law: being the Full Text of the New Law for Patents, passed July 1, 1877, covering all the States of the German Empire.

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CARRYING PEACE INTO AFRICA.

To carry war into Africa has been a proverb ever since Rome vowed the destruction of Carthage. But the Carthaginian invasion was a modern episode in Africa's experiences of that nature. On one of the earlier monuments of Egypt there is figured a slave-hunter's raid upon an Ethiopian village, the horrid details of which are said by travelers to be an accurate picture of a slave raid of to-day. The same murderous work has been going on incessantly for at least 4,000 years: how much longer there is no telling. For all these ages the African borders have known war and war only, and of the most destructive and barbarizing nature.

Recently, under the influence of Sir Samuel Baker, Colonel Gordon, and the civilized world in general, the Khedive of Egypt has carried war into the interior in the interests of peace: a conquest in a measure justified by the suppression of inter-tribal war for the filling of slave pens, and the abolition of the slave trade down the Nile. A similar reform has been effected on the east coast by the pressure of English power on the Sultan of Zanzibar. And the immediate effect of these two movements has been to prevent the butchery or enslavement of not less than half a million negroes annually.

A still more promising invasion of Africa has just been decided upon in the International Geographical Conference in Brussels: an invasion wholly in the interests of peace and civilization. At the meeting, a year ago, it was declared advisable to establish, by international effort, a line of permanent commercial stations from Bagomoyo, on the coast of Zanzibar, to St. Paul de Loanda, on the opposite Atlantic coast; the first stations to be at Ujiji, where Stanley found Livingstone, on the eastern shore of lake Tanganyika; at Nyangwe, Livingstone's furthest point northward on the Lualaba; and at some point further west on the route of Cameron, to be fixed in the dominions of Muata Yamvo, one of the most powerful chiefs of Central Africa. At the second conference, which ended June 24, arrangements were made for sending out the first expedition toward Tanganyika.

The object of the proposed stations is the development of civilization by commerce, not by religious propaganda. Primarily they will serve as bases of operation for explorers of the interior, a sort of *entrepôts*, where the explorer may supply himself with provisions, instruments, and goods, and thus save the cost and embarrassment of an army of porters from the coast. They will also serve as places of refuge for explorers in times of sickness and other reverses, which have hitherto so terribly hampered explorers. The heads of these pioneer establishments are to be men of scientific training and proved executive ability; and each will be aided by a physician-naturalist and a few skilled artisans. The points thus far chosen are on a line regularly traveled by the caravans of Arab traders, carrying coffee, tea, sugar, arms, and woven goods to permanent Arab residences and trading stations in the interior. An agent of the London Missionary Society has already begun the survey of a route for ox teams as far as lake Tanganyika; and Cameron has expressed the opinion that a light narrow-gauge railway could be constructed from the coast to the lake at a cost not exceeding four thousand dollars a mile. The traffic along such a road, he thinks, would soon pay interest on the outlay.

The unexplored region thus to be opened up to civilization and commerce (other than in human beings) is larger than the United States east of the Mississippi. Around it is a still larger region of partially explored country of unequalled fertility, abounding in great lakes and navigable rivers, and for the most part so high above the sea that the products of the tropics mingle with those of the temperate zone. The cereals, durah, maize, rice, sugar cane, starch-yielding roots and tubers, cotton, coffee, tobacco, spices, gums and caoutchouc, dye-stuffs and medicinal plants, the banana, fig, date, orange, and the vine are among the known products of this region; and all are capable of becoming important staples of foreign commerce. The country is not less rich in coal, iron, copper, gold, and other valuable minerals. The climate, though moist from abundant rain, is less debilitating than India or Brazil; and everywhere, away from the miasmatic coast regions and the marshes of the lower river courses, European explorers have found small cause for complaining of excessive heat or unhealthiness. On the elevated plateaus which cover so large a part of Central Africa, the climate is like that of the sanitariums of India; while among the mountains the finest climates of the world are fairly rivalled. Stanley found in the mountainous region between the great lakes and within a degree of the equator every climatic condition and every element of landscape beauty that could attract and delight a white colony. It was a perfect alpine country, with mountains rising from twelve to fifteen thousand feet, yet free from alpine cold and snow. Countless torrents from the hills watered ever-verdant valleys as beautiful as those of Tyrol, lying under a brilliant equatorial sun, yet with a climate as cool and equable as any European might desire. Further south, among the mountains about Lake Nyassa, the same features are presented on a grander scale: a country aptly described as a second Switzerland of gigantic proportions.

There can be no question of the ability of Europeans to sustain themselves in the greater part of the interior—certainly on all the higher plateaus—nor of the possibility of building up in Central Africa a great civilized empire. Nature offers every facility, and the native population seem to be well fitted for productive industry. In every respect they are physically and morally superior to the negroes of

the coast, and only need protection and the encouragement of legitimate commerce to weld them into a great nation. Already they stand on the borders of civilization. They are intelligent, industrious, and not unskillful in the manufacture of iron and copper ornaments, utensils, and weapons. The arts of tanning, spinning, weaving, dyeing, mat-making, etc., are widely diffused among them, and many of their products are remarkable for their fineness and strength. They carry on agriculture with considerable success; and, notwithstanding the chronic state of insecurity incident to slave-hunting, their wealth in cattle is very great. As soon as the disturbing and impoverishing influence of the slave traffic is abated, and a market provided for the products of peace, the advancement of the people in civilization is likely to go on with great rapidity. As the source of raw materials which we need, and as a market for the surplus manufactures of Europe and America, the country offers, to say the least, many attractions; and it will not be surprising if, within fifty years, thriving commercial stations will be founded on all its great lakes and rivers, and connected with the outer world by telegraphy, railways, and steamship lines.

ADDRESS OF CLARENCE KING ON CATASTROPHISM.

Mr. Clarence King lately delivered an interesting address before the Sheffield Scientific School of Yale College, New Haven, Conn., under the title of "Catastrophism, or the Evolution of Environment," which promises to evoke considerable discussion. We subjoin an abstract of the principal features of the address, which is quite lengthy. The full text will be found in our SUPPLEMENTS, Nos. 80, 81.

Mr. King refuted the doctrine of slow evolution as taught by Huxley and Darwin, and declared that the surface of the earth and climate had been subject to sudden and catastrophic mutation, which included in its environment all types of life.

He reasoned that marine fossils are found entombed in rocky beds far remote from present seas; and that these beds were once sea bottoms that have been upheaved by convulsions of Nature. The earliest history of mankind is pregnant with catastrophe, and we have historic story and biblical record of its sudden and destructive energy. He called to mind the vast and massive eruptions of the Pliocene basalt as seen upon our own continent.

The great obvious changes in the rocky crust were referred to a few processes; the sub-aerial decay of continents, delivery by streams of land-detritus into the sea, the spreading out of these comminuted materials upon a pelagic floor, and lastly upheaval, by which oceanic beds were lifted up into subsequent land masses. All these processes he declared to have been more rapid in the past than now. Suddenness, world-wide destructiveness, were the characteristics of geological changes. Periods of calm, like the present, are suddenly terminated by brief catastrophic epochs. Successive faunas and floras were created only to be extinguished by general cataclysms.

He believed in recurrent, abrupt accelerations of crust change, so violent as to destroy all life on the globe. He declared the idea to be the survival of a prehistoric terror, and was backed up by breaks in the great palæontological record.

Of the geologic features of our continent, he said that beneath our America lies buried another distinct continent, which he called Archæan America, which was made up of what was originally ocean beds lifted into the air and locally crumpled into vast mountain chains, which were in turn eroded by torrents into mountain peaks. The original coast lines of this continent we may never be able fully to survey, but its great features, the lofty chains of the mountains which made its bones, were very nearly co-extensive with our existing systems, the Appalachians and Cordilleras. The cañon-cutting rivers of the present Western mountains have dug out the peaks and flanks of those underlying, primeval up-lifts and developed an astonishing topography; peaks rising in a single sweep 30,000 feet from their bases, precipices lifting bold, solid fronts 10,000 feet into the air, and profound mountain valleys. The work of erosion, which has been carried on by torrents of the quaternary age, brings to light buried primeval chains loftier than any of the present heights of the globe.

At the close of the Palæozoic age, two enormous masses of what, probably, were then continents began to sink, and as they disappeared the present Atlantic and Pacific oceans appeared, while the sea-floor of a then ocean, emerged, and became the new continent of America. Dividing this new continent was a sea, but catastrophe removed this sea and resulted in the folding up of mountain ranges 20,000 and 40,000 feet in height, thereby essentially changing the whole climate of the continent. Of the land life of the mesozoic age we have abundant remains. The wonderful reptilian and avian fauna of the mesozoic age is now familiar to all. But after the catastrophe, and the change of climate which must necessarily have ensued, this fauna totally perished.

After criticising the opinions of Huxley, Lyell, Hutton, Darwin, and others, he recurred to the effects of sudden terrestrial or cosmical changes, and conceived that the effects of these changes would be, first, extermination; secondly, destruction of the biological equilibrium; and thirdly, rapid morphological change on the part of plastic species. When catastrophic change burst in upon the ages of uniformity, and sounded in the ear of every living thing the words "Change or die!" plasticity became the sole principle of salvation. And plasticity is the key to survival and prosperity. Mr. King remarked in conclusion of his address: "He who brought to bear that mysterious energy we call life upon

primeval matter bestowed at the same time a power of development by change, arranging that the interaction of energy and matter, which make up environment should, from time to time, burst in upon the current of life and sweep it onward and upward to ever higher and better manifestations. Moments of great catastrophe, thus translated into the language of life, become moments of creation, when out of plastic organisms something newer and nobler is called into being."

DUPLEX EDUCATION.

The age in which we live is a fast one, and he who does not move with equal celerity, and keep pace with those around him, is ruthlessly thrust to the wall, and remains there unless he has strength and will to regain the lost position. We call to our aid every force of Nature and invoke the assistance of every appliance with which we are cognizant. We call our fathers slow, and to us they were so; but there was the same need of celerity in their every-day life as to-day there is in ours.

While calling to our aid the elements of Nature and adapting thousands of mechanical appliances to our wants, do we not often feel that there is beyond all these a "something" that may be invoked and trained to help us on in the race of life? Occasionally we find dim glimmerings of this "something" that we believe will eventually grow to be one of the prominent sciences. Physiologists tell us that the human brain is double, that the right and left lobes act in a degree independent of each other—the right lobe of the brain controlling the physiology of the left side of the individual from head to heel, while the left lobe exercises a like dominion on the opposite side. Grant this to be true, then can be explained the idiosyncrasy that is occasionally seen in individuals, of which we may instance that of writing at the same time with both hands; and again we have heard of telegraph operators sending and receiving two messages at the same time, operating with both hands and independent of each other. It is said that Nasmyth, the inventor of the steam hammer, could actually produce two sketches or drawings in this way and at the same time. It is also affirmed that Sir Charles Fox, the architect of the Exhibition building of 1851, could write upon two ideas at the same time and transfer these ideas simultaneously to paper with right and left hand. The mechanic can often be found who can operate upon one piece of mechanism, while at the same time his brain is busy upon the study of some unborn idea, foreign to that work upon which he is laboring. Writers can be found who can write out one train of ideas, while ideas entirely different are being cogitated upon somewhere in their craniums. We have even heard it affirmed that an indistinct glimmering of a third idea would occasionally peep around the corner of the caputs of these favored ones.

Why not educate this? Why not form schools and institutions to bring it out and lead the brain to perform this double function? It can certainly be done. The world wants it, surely. The age demands it. Individuals need it. If these individuals can succeed and become experts in this method of double work, will not double compensation and a greater remuneration be their reward? This, certainly, will be an incentive to its acquirement. Go to the apprentice when first he takes position beside the vise, with chipping chisel in one hand and hammer in the other. The injunction he mentally receives as he raises the hammer is, that to miss the chisel is to hit his knuckles. After a few demonstrative blows he knows what it means, and therefore chisel and hammer soon come by some strange process to harmonize in action, so that in whatever position the head of the chisel may be, the blow is sure to be properly received, and that, too, without any sensible effort on his part. In this illustration both right and left hand are taught to act, by brain dictation, in a certain concerted manner.

Again, we find that mutes have been learned to articulate words and sentences by proper education, they being taught to imitate the motions of the mouth and labial organs as by their tutors directed. Education can do much, and these are some of its results. Can we not by proper teaching produce all the results as shown in the case of Nasmyth and Fox. The first lessons must necessarily be simple. For instance, two things done at the same time with both hands, giving expression at this time to ideas connected therewith, but distinct from each other. From this simple lesson we progress, and, as the ultimatum, we may arrive at greater achievements than Nasmyth or Fox ever dreamed of. We may find that we can so divide our entity that we can be conscious of a double-brain existence in a dual action.

THE CARRIGEEN CROP.

To the great majority of people, Carrigeen, under the more familiar name of Irish Moss, is known chiefly as the basis of a pleasant and wholesome drink for the sick room, or as an article of use in the preparation of delicacies for the table. Comparatively few are aware of its wide and varied use in the arts, or that the thousands of barrels of it employed annually by our manufacturers of paper, cloth, felt, and straw hats, etc., and by brewers, is not an Irish, but an American product, and, speaking strictly, is not a moss but a seaweed.

Carrigeen (*chondrus crispus*) is to be found more or less abundantly all along our northern coast, ranging between the low water line and the depth of forty feet, or so; but as a rule its fronds, which correspond to the leaves of air plants, are so numerous inhabited by small mollusca that they are spoiled for other use. The clean-growing article seems to be

limited almost wholly to certain ledges in the neighborhood of Scituate, Mass.—a section of coast guarded by the celebrated Minot Ledge Lighthouse, and famous for its danger to shipping. Here, where the waves of the Atlantic dash with full force upon the rocky coast, the carrigeen grows to perfection; and wherever it escapes the spawn of mussels and other shellfish, is gathered during the summer season in vast quantities.

The harvest begins in May and ends about the first of September. The gathering is made in two ways—by hand-picking during exceptionally low tides, and by means of long-handled iron-toothed rakes at ordinary tides. Of course the work cannot be carried on except during fair weather. Hand-pulling is possible only during the bi-monthly periods of spring tides, that is, when the moon is full and again at new moon. At such times high tide occurs about midday and midnight, and the ledges are exposed for moss gathering morning and evening. The mossers' boats are rowed to the rocks where the finest grades abound, and the gatherers select with great care the growths that are freest from minute shells and other foreign matter. This portion of the crop, if properly handled afterwards, generally goes to the apothecary and fetches a price two or three times that of the common grade.

As the tide rises the pickers are driven to their boats, and proceed to the outer moss-bearing rocks where the rake is used, as it also is during ordinary low tides. Moss taken in this way is not so clean as the hand-picked, and is always mixed with tape grass, which must be removed during the process of curing and packing.

The curing of the moss is the most critical part of this peculiar farming. On being brought to the shore the moss is black and unsightly; it must be bleached as well as dried. The bleaching is effected by repeated wetting and drying in the sun; and as the moss is readily soluble in fresh water the bleaching beds are situated near the banks of the salt creeks that abound along the shore. After drying, the moss is packed in tubs and rolled to the water, where it is thoroughly washed, then rolled back to the bleaching bed, to be dried again in the sun. Five or six such exposures are usually sufficient. On the bleaching ground, the moss is carefully spread and turned, and watchfully guarded against wetting by rain. In this process it turns from black to red, then to the yellowish-white of the perfected article. When properly cured the moss is stored in bulk, in shanties; where, as time permits, it is picked over and packed in barrels. The crop averages about half a million pounds a year; and thanks to the brighter and more abundant sunshine of our coast, the moss has a brighter color and is of finer quality than the Irish product.

CATASTROPHISM IN GEOLOGY.

Mr. Clarence King was probably not a little surprised to learn from the *Tribune* that in his most suggestive address on "Catastrophism and the Evolution of Environment," he had turned the guns of Geology upon Biology; and that in calling attention to the influence of periods of accelerated change in environment upon exposed types of life he had swept away the "fundamental doctrines upon which has been built the scheme of development by natural selection and the survival of the fittest." Certainly nothing in the address betrays any consciousness of possible effects of that sort. And it is quite probable also that Mr. King will have to suffer some annoyance from seeing his name set up at gaze, like Joshua's moon in Ajalon, by the unscientific press generally, as that of the newest champion of orthodoxy against the leaders of modern scientific thought: a penalty which scientific men always have to pay for emphasizing neglected truths.

Mr. King certainly deals some telling blows against the position of the stricter school of Uniformitarians in geology, and brings into prominence a much neglected element in the struggle for existence; but there is no scientific revolution threatened, nor are any crumbs of comfort spread for those endeavoring to arrest the natural drift of scientific progress.

The issue between Mr. King and the sticklers for uniformity in rates of geological change is simply this: In the reaction against the sweeping cataclysms, the sudden wipings out of whole creations and the sudden introductions of new worlds of life believed in by earlier geologists, the modern English school has come to look upon time and the slower modifications of the earth's surface, now observable, with the struggle for existence under easy conditions, as the chief factors in geological change and its accompanying variations in the forms of life. Mr. King, on the other hand, insists that in so doing they have taken too little account of catastrophic changes, that is, widespread and sudden movements of sea and land. In other words, he raises rapid change of environment from the subordinate place it has hitherto occupied in the scheme of historical development, and gives special emphasis to the grand geologic movements which have to do with such changes.

In this Mr. King has unquestionably rendered good service to the science he has done so much to extend and honor in the field; while the illustrations from American geology which he brings to bear on the subject are as likely as his sturdy opinions to attract attention. Yet we are inclined to think that in some things he has allowed his enthusiasm to run away with him. The stolid self-confidence of extreme Uniformitarians has tempted him to exaggerate the periodic accelerations of geologic and biologic movement, and to overstate their effects quite as much as others have underestimated them; and when he charges the followers of Lyell

with intellectual near-sightedness and a lack of "the very mechanism of imagination," they may possibly be able to retort not unjustifiably that he has mistaken the natural foreshortening of the geological vista due to distance for actual brevity; and that his belief in the abruptness and suddenness of the great changes which the earth's strata record, may be due to his own lack of sustained imaginative power for grasping and interpreting all the evidences of the enormous time really involved. But this is a question not of imaginative capacity but of logical deduction from observed facts; and however abrupt the beginning of some of the great geologic movements may have been, their subsequent progress cannot in all cases have been so rapid as to allow of their being called catastrophic in any ordinary acceptance of the term.

Take, for example, the alleged catastrophe which marked the close of the mesozoic age in the West. Of this movement Mr. King remarks: "In a quasi-uniformitarian way, 20,000 or 30,000 feet of sediment had accumulated in the Pacific and 14,000 in the [American] mediterranean sea; when these regions, which, during the reception of sediment, had been areas of subsidence, suddenly upheaved, the doming up of the middle of the continent quite obliterating the mediterranean sea and uniting the two land masses into one. The catastrophe which removed this sea resulted in the folding up of mountain ranges 20,000 and 40,000 feet in height, thereby essentially changing the whole climate of the continent."

That this great change occurred, and was attended with an obliteration of the wonderful reptilian and avian fauna of the mesozoic age, is most true: that it occurred suddenly does not appear. On the contrary, there is evidence to show that the prodigious folding up of mountain ranges involved could not have proceeded with sufficient rapidity to turn the course of a stream of water. It happened that one of those folds—one which, had no denudation been going on meanwhile, would have lifted its crest higher than the highest peak of the Himalayas—lay directly across the course of the Colorado river. The river held its course uninterrupted, sawing its way through the uplift until six vertical miles of rocky strata had risen past it. At no time, therefore, could the rapidity of motion in the bulging strata have exceeded the capacity of the river to wear away the obstruction, and the bulge was fifty miles across! We do not know how rapidly a river may sink its channel through such a rising barrier; but we do know that a process of that nature cannot legitimately be described as swift or sudden. And surely it requires not less intellectual far-sightedness and imaginative faculty to carry the mind across the enormous stretch of time involved in such a change slowly wrought—a period during which at least three vertical miles of the rising mountain fold was worn down by rain and atmospheric abrasion—as to mass the continental doming, the mountain folding, and the attendant life changes together as a convulsive "catastrophe."

Mr. King, however, is not a Catastrophist of a very violent sort. He shelves among the errors of the past the belief in such cataclysms as Cuvier believed in, involving world-wide destruction of all life—"the mere survival of a prehistoric terror, backed up by breaks in the palæontological record and protected within those safe cities of refuge, the Cosmogonies;" though he rejects as equally unsatisfactory the mild affirmations of the Uniformitarians, that existing rates of change and indefinite time are enough to account for all the geological record. With our present light, he holds, geological history seems to be a dovetailing together of the two ideas. "The ages have had their periods of geological serenity, when change progressed in the still, unnoticeable way, and life through vast lapses of time followed the stately flow of years; drifting on by insensible gradations through higher and higher forms, and then all at once a part of the earth suffered short, sharp, destructive revolution unheralded as an earthquake or volcanic eruptions." Thus stated, his position does not seem to be radically different from that of the broader Uniformitarians, except that he marks the periods of accelerated physical change, and not those of comparative quiescence, as the dominant ones in their influence on life-change. He takes high and strong ground, too, in insisting that it is the business of geology not simply to decipher and map out the changes which have taken place in the configuration of the globe and in its climatic conditions, but also to investigate and fix the rates of change. And when the evolution of environment takes form as a distinct branch of geology, he expects to witness a marked modification in the dominant views of biologists. Its few broad laws will include "neither the absolute uniformitarianism of Lyell and Hutton, Darwin and Haeckel, nor the universal catastrophism of Cuvier and the majority of teleologists." "Huxley alone among prominent evolutionists opens the door for a union of the residue of truth in the two schools, fusing them in his proposed evolutionary geology."

So, on looking back over a trail of thirty thousand miles of geological travel, Mr. King is impelled to say that Mr. Huxley's far-sighted view perfectly satisfies his interpretation of the broad facts of the American continent.

Of Mr. King's observations in regard to plasticity of physical structure in connection with rapidly changing environment and the struggle for existence, we propose to speak at another time.

THE great stone monuments of England, like Stonehenge, are supposed, by Mr. James Fergusson, to be military trophies, erected in the time of King Arthur on the battle fields by the victorious armies.