# Scientific American.

ESTABLISHED 1846.

### MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT DADK DOW NEW YORK

0. D. MUNN.	A. E. BEACH.
TERMS FOR THE SCI	ENTIFIC AMERICAN.
One copy, one year, postage included	
One copy, six months, postage include	d 1 60
Club R	ates.
Ten copies, one year, each \$2 70, postag	ge included
Over ten copies, same rate each, postag	ge included 3 70
The postage is payable in adv	ance by the publishers, and the sub-
soriber then receives the paper free of	
NorgPersons subscribing will pies	
Office and State address, plainly writte	en. In case of changing residence
state former address, as well as give the	a new one. No changes can be made
unless the former address is given.	
unless the former address is given. Scientific America	an Supplement.
unless the former address is given. Scientific Americ A distinct paper from the SCIENTIF	an Supplement. 10 AMEBICAN, but of the same size,
unless the former address is given. Scientific Americ A distinct paper from the SCIENTIF and published simultaneously with the	an Supplement. 10 AMEBICAN, but of the same size, regular edition.
unless the former address is given. Scientific Americ A distinct paper from the SCIENTIF and published simultaneously with the T E R	an Supplement. 10 American, but of the same size. regular edition. MB.
unless the former address is given. Scientific Americ A distinct paper from the SCIENTIF and published simultaneously with the TER One year by mail	an Supplement. NO AMERICAN, but of the same size, regular edition. M S
unless the former addross is given. Scientific Americ A distinct paper from the SCIENTIF and published simultaneously with the T E R One year by mail	an Supplement. 10 AMERICAN, but of the same size, regular edition. M B
unless the former address is given. Scientific Americ A distinct paper from the SCIENTIF and published simultaneously with the T E R One year by mail	an Supplement. 10 AMERICAN, but of the same size, regular edition. MIS
unless the former address is given. Scientific Americ A distinct paper from the Scientif and published simultaneously with the TER One year by mail	an Supplement. 10 AMERICAN, but of the same size. regular edition. MB
unless the former address is given. Scientific Americ A distinct paper from the SCIENTIF and published simultaneously with the T E R One year by mail	an Supplement. NO AMERICAN, but of the same size, regular edition. M S. T, to one address

VOLUME XXXV., No 12. [NEW SERIES.] Thirty-first Year.

#### NEW YORK, SATURDAY, SEPTEMBER 16, 1876.

Contents. (Illustra.ed articles are marked with an asterisk.) ettric ectric light de tric valve manue, speed of an (2, 25)... fugine, the Lidgerwood rotary Engratum, skeet plate. France, seensible assertion for. Gages, the battle of the ... Ganolds, North American. Gatods, North American. Gatods, North American. Giveeria, burning (31). Giveeria, burning (31). Hair, failing mercury from (43) 188 Steam Joints, rusting (13). Gunpowder, power of (19). Hair, failing mercury from (43) 188 Steam Joints, rusting (13). Heat (14). Heat (14

## For the Week ending September 16, 1876. With 67 Figures.

#### TABLE OF CONTENTS.

TABLE OF CONTENTS.
TABLE OF CONTENTS.
THE INTERNATIONAL EXHIBITION OF 1376. With 11 illustrations.The Swedish Meteorograph, 1 engraving, --West Virginia State Bullding, 1 engraving, --The Gold and Silver Display.-British Colonial Gend.-Silver Exhibits.-South American Gold and Silver.-Gold Silver.-European Exhibits.-American Gold and Silver.-Gold Ores.-Silver Ores.-The Mississippi State Bullding, 1 engraving, --Machine Tools at the Exhibition, 7 engravings, Bolt Cutter, Boring Machine, Drilling and Chucking Ma-Machine, New Yies, Cutting Latite, Power Press.-The Baldwin Locomotive Works Exhibit, 1 engraving.

Instruct, N. S. Status, Lower, Lower, Lower, Pross. - 1 ne Baldwin Locomotive Works Exhibit, i engraving.
 ENGINEERING AND MECHANICS. With 22 illustrations. - Steel Railway Cars. 1 engraving. - Steel-Making Immigrants. - A New Road Pavement by M. K. Coozens, C. E. -Bilding Associations in Philadelphia. - L'autha Process for Gold and Silver Ores, 1 engraving. - Casson's Yew Goas Furnace for Slack, 1 engraving. - Muir's New Street Railway Car, 2 engravings. - Effect of Railways on Material Progress. - Waterworks, Ancient and Modern, 26 fagures, - On Fly Wheel Accidents. - GeographicalStadiometer, 1 engraving. - Cutting Tools for Lathes and Planetrs, by Josuta Rose, 9 figures. - New Process of Sulphur Extraction. - Incubation Silk worm Eggs by Electricity. - Anthrapurpurine. - Eosing upon Various Stuffs. - Fourteen New Dyeing Recipes. - Horse Power Pumn 1 figure. - Cheap Photo Plate Holder, 1 figure. - Cheap Rock Breaker, 1 figure. - The Keely Motor.
 IV. LESSONS IN MECHANICAL DRAWING. by Professor MacCorp. 1

IV. LESSONS IN MECHANICAL DRAWING, by Professor MACCORD, 1

#### AMERICAN CONTRIBUTIONS TO THE DEVELOPMENT THEORY.

The address which has deservedly attracted the greatest share of attention, out of the many learned essays delivered

at the recent meeting of the American Association for the Advancement of Science, is Professor E. L. Morse's masterly summing up of all that America has done to promote the growth of the development theory. Professor Morse is an ardent evolutionist, a naturalist of great learning and abilty, an indefatigable investigator, and, like most prominent men in the scientific world, has no hesitation in assuming the offensive in support of doctrines of the truth of which he is deeply convinced. Hence there is nothing resembling rimming in his discussion of the evolution question, the opponents of which receive scant mercy at his hands; but still very many of those whose scientific faith is thus atacked are among the Professor's warmest admirers, for he possesses the happy faculty of being always instructive, always original, and of lifting his topics out of the slough of echnical pedantry in which too many of our learned scienists seem over inclined to bury modern acquisitions to our nowledge, especially of natural history.

Professor Morse tells us that the first clear premonition of he doctrine of natural selection came from an American. William Charles Wells, borne at Charleston, South Caro ina, in 1757. In 1813 Wells read a paper before the Royal Society, in which he attempted to account for the color of lark-skinned races of men by citing the changes of aninals under domestication, showing that varieties of men and animals were occurring, not exceptionally, but constantly, and that different breeds of animals were thus obtained by man's selective supervision. Hence he argued that a similar selection among men had been effected by the compara tive immunity from certain diseases of those who had dark skins. This is substantially a part of the theory of natural selection now expanded by Darwin and credited wholly to him; but the verdure of originality, it seems, must now fade from the English naturalist's laurels. The honor belongs to an American inventor, who, like hundreds of his brethren since his day, has furnished the thoughts whence have sprung some of the most noted of foreign "discoveries." This is unquestionably the most important fact broughtforward in Professor Morse's paper, and it will provoke uni versal comment.

Classifying the work of various American investigators, Professor Morse tells us that in producing new evidences for the doctrine of natural selection. Drs. Burt G. Wilder. Englemann, and W. K. Brooks and Professor Charles V. Riley have borne distinguished parts. Professor Riley's proof of the inter-dependence of flower and insect in the case of the yucca moth is a scientific triumph. The late Professor Jef fries Wyman completely ruined the beautiful theory that the cells of bees were of such construction as to use space and material to the best possible advantage. He found by close study that the cells of all cell-making insects are of all grades, from shapeless masses to those which approach but never reach perfection. The late Professor Chauncey Wright also did admirable work in showing that the arrangement of leaves of plants along their axis, was due to circumstances of growth, and was not a circumstance of blind law.

Professors S. F. Baird, J. A. Allen, and Robert Ridgway severally have found that marked differences in birds and mammals are due solely to their surroundings. Thus, for example, Western birds have longer tails than Eastern ones of the same species, and on the Pacific coast birds acquire a darker hue. Large numbers of like changes, when tabulated and shown on a geographical chart, were found coinci dent with variations already ascertained in the amount of rainfall in the different regions. The total number of species of birds was reduced about one fifth by these investigations, and the number of species of squirrels decreased one half or more.

As evidences of the transmutation of species, Mr. James Lewis has discovered that a truncate form of mussel, which, by the loss of one of its segments, had been distinguished from another form, takes its peculiar shade from the circumstances to which it had been exposed, namely, the abrasion of its edges and consequent retarding of its growth in the rapid currents of the Mohawk River. Mr. A. G. Wetherby has called attention to changes in snails under like conditions; and Dr. Cooper and Messrs. Stearns, Bland, and Birney, have all described instances in which changes in animals have followed altered circumstances of heat or mois-Among the examples of the survival of forms h ITA adaptation to changed environment, the discovery by Mr. Ernest Ingersoll of marine mollusks and living salt water crabs, high up on the Rocky Mountains, is the most remarkable Professor Marsh has made a series of brilliant researches concerning the siredon, an animal of the salamander kind, that loses its gills, and becomes, when removed from its natural habitat, one previously recorded under an entirely different genius (amblystoma). The researches of Drs. Packard and Putnam have overthrown Agassiz' theory that the blind fish of the Mammoth Cave are of a race crea ted in their present condition by showing that a whole series of fishes, ranging from those with perfect eyes to those without any, including between them various deficiencies of vision, have been found in American caves and secluded wa ters. The discoveries of Professors Leidy, Marsh, and Cope, among the tertiary mammals of the West, have filled wide gaps between older and existing forms, showing all the intermediate animals, so that we have nearly the whole ances try of the horse, back to the five-toed animal, not larger than a fox, in the cocene period.

sets forth the present theories of Darwin and the evolution school, and more especially dwells upon the gradual devel opment of the intellect of animals. The earliest mammals had the smallest brains; and as we go upward in the strata, the size of the brain gradually increases. Its development in the monkey tribe was regarded as the means by which these animals were enabled to escape from the carnivora which formerly abounded: and intellect even in that early era thus proved its superiority to brute force.

In his conclusion, Professor Morse showed how perfectly the evolution doctrine accounts for the fatalism of the Turks, the cruelties of savages, and the outrages generally among civilized people, attributed to the total depravity of humanity. He considers all such manifestations as simply relapses to the savage nature which we all inherit from animal progenitors; and that where such relapses in any individual become constant, it is the duty of society to treat that individual practically as it would a dangerous beast, and so govern him as to prevent his propagating his kind.

#### THE COMING EXPLOSION AT HELL GATE.

General Newton has recently stated that the great explosion at Hell Gate will take place during the latter part of September. The excavations have been complete for some time past, but delays in passing the appropriation bill by Congress checked further operations, and for this reason the blow-up did not occur on the 4th of July, as for a long period was contemplated. Those who expect to witness a gigantic column hurled hundreds of feet into the air, or look forward with some trepidation to the effects of fearful concussion on adjacent buildings, will hardly find their anticipations realized. The mine will be flooded previous to the explosion; and with the possible exception of jets forced through seams in the rocks, there is no reason to believe that any very remarkable exhibition of the tremendous force of the explosives will be manifest. From a scientific point of view the occasion will be of considerable interest, as the earth in the vicinity will be shaken by the communicated vibrations, which are likely to travel over a long distance. An opportunity will thus be afforded for measuring the velocity of sound waves through earth, and preparations are being made by scientific men to observe the same at points at distances 200 and 300 miles away.

The arrangements to guard against any possible danger are being perfected, in utter disregard of the desires both of those who hope to see the great blast, and those who aspire to profit pecuniarily through the popular curiosity. Steamboats and other craft will be warned away, so that a view from the river will be out of the question; the authorities have been requested not to grant passes to would be spectators on Ward's Island, the best point of observation; and a bluff of earth and the buildings near the works prevent seeing the operations from the rear, so that the expectant populace will probably have to satisfy themselves with a distant view from the high land on the New York shore.

How much powder, etc., will be burnt is not yet definite ly stated. An approximate idea of the quantity may be gathered from the fact that there are about 4,000 drill holes. each 3 inches in diameter, and varying from 7 to 13 feet in depth. Each will be charged with a separate canister of dynamite, vulcan, and rend-rock powder, and the simultaneous explosion will be effected by the current from a batterv of 800 cells. About two pounds of powder are used to one of dynamite, and the charges are inserted in the 173 piers of rock and in the roof supported thereby. It is estimated that 30,000 cubic feet of broken rock will be left under water, and this will have to be removed by dredging so as to secure a channel 26 feet in depth. The total length of tunnels, galleries, etc., excavated, is 7,425.67 feet. The amount thus far expended is \$1,686,841.45.

#### CHEAP COAL.

The breaking up of the coal combination and the consequent throwing upon the market of half a million tuns of coal is a welcome event. The whole coal trade of the East has, for several years, been under the absolute control of a monopoly which has signalized its sway by unwaveringly maintaining high prices, without regard to the demand first, or the depressed condition of all business affairs. It is characteristic of the patience of our people that no means have been tried to mitigate this condition of things; but now that the crisis has come, it is like a gleam of sunlight through the black shadows which have fallen across the prosperity of the industrial world. When coal is once more bject to the natural laws of trade. and not until then its traffic rest on a sound basis; and when this comes to pass, then we may look for a revival in iron manufacture, and in all the industries in which steam is used. Too many people are undergoing the effects of long existing business stagnation not to watch eagerly for any sign, however faint, indi. cative of better times, and therefore the gratification felt and openly expressed, at the collapse of the combination, is undeniably great. One public sale of 500,000 tuns will not affect the whole winter's trade, however, any more than one cold day represents the whole winter's weather; but as matters now appear, the present event is only a beginning, and predictions are freely hazarded that we shall see still lower prices. The fall in rates at the late auction seem to have astonished every one, and none more than the coal dealers themselves. The reduction from the combination schedule for August averages about \$2.10 per tun, and average prices ranged from \$2.20 for Philadelphia & Beading chesnut to \$3.86 $\frac{5}{10}$  Delaware & Hudson stove. The Vice-President of the Pennsylvania Coal Company asserts that it would cost

- page of illustrations.
  V. ELECTRICITY, LIGHT, HEAT, SOUND, ETC.—Illumination by the Electric Light, I IGHT, HEAT, SOUND, ETC.—Illumination by the Electric Light, I IGHT, HEAT, SOUND, ETC.—Illumination by the Electric Light, Electron bicharges.—Radiometer Experiments.—Nature of the Zodia-cal Light.—Electricity as a Motor.—Chutaux's Electro-Motor.—Electricity ortices, 8 figures.
  VI. CHEMISTRY AND METALLURGY.—Roscoelite, a Vanadian Mica.— Paradol.—Methods of Chemical Decomposition, by Professor Glapsrow. Store.—Decomposition by Electricity by Chemical Affinity, by Heat. —The Copper-Zinc Couple.—Nitrates in Water.—Union of Chioral Hydrate and Camphor.—Erythrogen.
  VI. NURAL HISTORY. MINERALOGY. ETC.—Borax. Sulphur. and
- Interview and a solution of support of the solution of support. Hereby and solid-ficking the solution of support of the solution of the s

#### The Scientific American Supplement

is a distinctive publication issued weekly; every number contains 16 oc-tavo pages, with haudsome cover, uniform in size with SCREATIFIC AMERI-OAN. Terms of subscription for SUPFLEMENT, \$5.00 a year, postage paid, to subscribers. Single copies, 10 cents. Sold by all news designs through-out the country.

MUNN & CO., PUBLISHERS, 37 Park Row, New York. All the numbers of the SUPPLEMENT from its commencement, January 1, 1875, can be supplied ; subscriptions date with No. 1 unless otherwise or-dered.

The remainder of Professor Morse's admirable address \$500,000 more to mine the coal than the prices fetched at