

Scientific American.

MUNN & CO., Editors and Proprietors.
PUBLISHED WEEKLY AT
NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS.

One copy, one year..... \$3 00
One copy, six months..... 1 50
CLUB RATES { Ten copies, one year, each \$2 50..... 25 00
 { Over ten copies, same rate, each..... 2 50

VOL. XXIX., No. 8 . . [NEW SERIES.] Twenty-eighth Year.

NEW YORK, SATURDAY, AUGUST 23, 1873.

Contents :

(Illustrated articles are marked with an asterisk.)

Accident, shocking.....	115	New books and publications.....	121
America, discovery of.....	119	Norway and Sweden.....	115
Answers to correspondents.....	128	Notes and queries.....	123
Base line of astronomy, the.....	112	Oil of vitriol is made, how.....	111
Beaulphoe of carbon engines.....	117	Page, Ezekiel.....	118
Boilers and boiler owners.....	116	Patent decisions, recent.....	121
Boilers upon stoves, water.....	118	Patents, official list of.....	124
Business and personal.....	123	Patents, recent American and for- eign.....	121
Cigar box, the patent revenue.....	118	Photo-process, new.....	115
Comets, the composition of the tails of.....	117	Plagues, origin of.....	115
Compasses, location of standard.....	118	Portable engine, the Cooper.....	119
Composite lenses.....	117	Preservation of wood, the.....	120
Cot, perambulating.....	114	Projectiles, explosive.....	117
"Dastardly outrage" again, that.....	113	Saddle trees.....	121
Efflux of steam.....	113	Sash cord fastener.....	115
Fan, the first automatic.....	119	Scientific and practical informa- tion.....	112
Friction of water in pipes.....	112	Spontaneous generation.....	113
Geological investigations, recent	112	Steam engine in the world, the largest.....	118
Inventions patented in England by Americans.....	121	Vienna exposition, the—Letter from Professor Thurston.....	116
Jumping from railway trains.....	116	Waste paper, uses of.....	120
Laws in midsummer.....	119	Watering house plants.....	120
Light, the physiological action of.....	120		
Motor, a new domestic.....	118		

THAT "DASTARDLY OUTRAGE" AGAIN.

We have been recently favored with a lengthy epistle from Mr. John Fehrenbatch, the author of a letter lately commented upon by us, relating to alleged grievances of workmen in the works of Messrs. Stearns, Hill, and Co., of Erie, Pa. The present document is little more than a repetition of the personal difficulties between the above named employers and their men, which, as we before remarked, is a subject interesting solely to the parties in the controversy and in no wise to the public. The circumstances have little or no bearing on the main question of the right of employers to hire or exclude exactly such persons as they please without resorting to outside dictation or advice.

Our correspondent mistakes the position we assume in regard to troubles of this nature, and evidently infers that we desire to champion the side of the employers as against the men in all cases and even in purely personal misunderstandings. We deal with these questions with reference to their effect upon one or the other of the great classes, employers or employed, impartially, and not with regard to any particular set of men or any especial establishment. If a concern treats its workmen in a manner calculated to give a basis for the generally unfounded assertions of trades' union demagogues, we endeavor by well meant advice to point out the fallacy and inexpediency of such a course; and similarly, on the other hand, we do not hesitate to condemn any body of workmen who, by attempts at intimidation or dictation, cause employers generally to adopt stringent measures calculated to restrict their privileges or injure their interests.

The letter before us includes an extract from a speech of the President of the International Union, in which the employers in question are stigmatized as "pirates and robbers of the rights of labor." This is not the way to bring about the amicable adjustment of any trouble. In our opinion, a wiser course would be to counsel moderation and proper respect for the rights of others.

SPONTANEOUS GENERATION.

All experiments thus far made with infusions of different substances, for the purpose of producing infusorial animalculæ, appeared to prove that the access of air was necessary for their formation. Pasteur, who has extensively occupied himself with these investigations, found at last that the germs of these animalculæ could, under certain circumstances, resist a temperature of 212° Fahr., as he obtained bacteria from solutions which had been previously boiled and afterward came only in contact with air which had been dried and purified by passing it through red hot pumice stone.

However, in 1869, Dr. H. Charlton Bastian took the matter up, and commenced trying if he could not produce animal life in a vacuum. He experimented with various fluids, especially infusions of hay and turnips; he placed them in one ounce flasks, having narrow drawn out necks, and heated the solutions in them rapidly till they commenced to boil over, so as to be sure that all air was expelled; then he kept them boiling for from a quarter to half an hour, while the steam was escaping with some force; then the neck was sealed up by melting the glass with a blowpipe flame, while at the same time the heat was withdrawn. In this way he produced after some practice a perfect vacuum, that is to say, one where air was excluded, and only watery vapor present. The proof of this was that the water hammer effect was quite obvious; this means that the water could be made to fall with a shock from one end of the tube to the other, without passing an atmospheric bubble, as is the case when air is present. When the little flasks were thus prepared, they showed the development of bacteria and other minute moving organisms just as well as if they had not been submitted to great heat, and air had access. The time required

for this phenomenon varied from a few hours to several days. Even when the flasks, after being closed, were submitted for several hours to boiling water, the organisms appeared; and Dr. Bastian went even so far as to submit them for four hours to a temperature of 300°, and about 6° in excess, without preventing the subsequent development of the animalculæ. He reasoned then as follows: As the germs cannot come from the air and pass through the glass, only one of two conclusions is admissible. 1. That the invisible germs of the animalculæ are able to stand a heat of 306° without being killed; or (2) that living things can be evolved from non-living matter.

The first conclusion is that of Pasteur, and is based on the assumption of the old maxim *omne vivum ex ovo* (all life comes from an egg), deduced from the fact that it is known to be true for all the higher animals and plants, and that its extension to the lower forms of life, which are intermediate between animal and vegetable, is supposed to be a legitimate deduction on the ground of natural law.

The second conclusion is that defended by Dr. Bastian; he maintains that the doctrine of evolution, now established by an overwhelming weight of evidence, absolutely requires that living matter must at some time have arisen from that which was not living, and that, in absence of any reason to the contrary, the uniformity of natural law should lead us to believe that the process continues to take place. He says that all analogy is against the possibility of the assumed germs retaining their life after being subjected to a heat of over 300°. No living being that we know of can endure the heat of boiling water, 212°, except a few seeds of the higher plants, which are protected by a very hard and non-conducting coat. Most animals and plants, indeed, perish at a much lower temperature. With regard to the bacteria themselves, they are mere specks of naked protoplasm; they are utterly destroyed at 140°, as sufficiently proved by the numerous experiments made by Pasteur, Bastian, and others. It is unlikely, therefore, that they should have germs capable of enduring 306°.

Experiments were also made by Dr. Bastian with fluids capable, after being boiled, of nourishing bacteria when any were put into them, and of supporting their copious reproduction, though not evolving them anew when enclosed in hermetically sealed vessels. The uniform result was that 140° not only kills all living bacteria, but also prevents the further development or reproduction of any germ which might be supposed to exist. The natural conclusion is that they do not exist, and therefore these experiments exploded the germ theory.

We hope that these investigations will continue so as to obtain uniform results; as only then can a full discussion of the possible explanations ensue. In the meantime, Dr. Bastian's experiments are drawing the attention of the most eminent philosophical naturalists. For instance, Alfred R. Wallace ranks Bastian's book as equal in value to Darwin's "Origin of Species," or Spencer's "Principles of Biology," especially in regard to "curious and novel facts," "new and astounding views of the origin of life," "excellent reasoning," and "acute criticisms."

There is, however, one point to which we wish to draw attention; it is the assumption that these living organisms are evolved entirely from inorganic matter. This, we believe, is not strictly correct; the infusions all have organic origin; they are organic compounds, and it is well known that the organic compounds are not decomposed into their inorganic elements, except by actual combustion. Starch, sugar, gelatin, etc., are not destroyed, as such, by a temperature of 300°, therefore, if we attempt to generate living organisms from inorganic matter, we must not commence by using organic substances, but must confine ourselves to elements, or their simple inorganic chemical combinations.

RECENT GEOLOGICAL INVESTIGATIONS.

M. Jules Marcou communicates some interesting geological notes to the French Geographical Society, gathered from various eminent sources, while preparing a new geological map of the globe, recently forwarded to the Vienna Exposition. In Spitzbergen, M. Nordenskjöld has found (independent of the crystalline rocks) palæozoic, carboniferous, triassic and tertiary formations. An important fact, from its bearing on the history of the earth, is the discovery of terrestrial flora dating from the tertiary miocene epoch, which show that the entire arctic polar region must have been covered with vast forests similar to those which now exist in the northern hemisphere as far north as the borders of the tropic of Cancer. In Norway, peat deposits have been found in Andæ Island, one of the Loffoden group, which, like similar beds in Yorkshire, England, are of the jurassic epoch. The existence, in Russia, of an enormous triassic formation has been determined; this had, heretofore, by Sir Roderick Murchison and others, been attributed to the Permian system. In Syria and Egypt, continuous and extensive deposits of red sandstone indicate the homogeneous nature of the rocks of Asia and Africa. On the other hand, the most recent geological studies, made in New Zealand, Australia, and some of the Pacific islands, prove that Madagascar, in spite of its proximity to the African continent, appears to belong to a totally distinct formation which closely resembles that of New Zealand and Western Australia. In South America, MM. Musters and Pourtalés have found a group of extinct volcanoes between the Gallegos river, Cape Virgin and the eastern entrance of the Straits of Magellan.

M. Marcou considers the classification of stratified rocks, as generally laid down in modern geological treatises, as very imperfect and not justified except in a portion of the northern temperate zone. In the West Indies and California, and on the Missouri river, he states that the difficulties of classifica-

tion augment in proportion as new discoveries are made. In the first mentioned part of the globe, for example, Dr. Waagen has found, in beds of limestone a foot and a half thick, forms of fossils which are generally distributed in very different deposits, and which are supposed to belong to carboniferous, triassic and jurassic rocks. These evidences are not accidental, but are multiplied in Nebraska, Illinois, California, Australia, and even in New Zealand.

THE BASE LINE OF ASTRONOMY.

When a land surveyor wishes to find the distance between two points, separated by an obstacle to direct measurement, say an impassable swamp or a sheet of water, he resorts to triangulation. To the right or left of the line to be determined, he lays off another line, from the extremities of which he takes the compass bearings of the points whose distance from each other he wants to learn. The angles thus found, together with the length of the measured line, are all the data needed for calculating the length of the required line. In extensive surveys, this principle of triangulation is used almost exclusively. A single base line is measured with great accuracy, and all the other distances in the survey are calculated by means of a series of triangles erected on it. The correctness of the entire work depends, consequently, on the exact determination of the length of the primary line. If there be an error in this, the utmost care in all subsequent observations and calculations cannot prevent the survey from going wrong. Hence the minute precautions always taken in choosing the site and determining the exact position of the base line, in reducing it to a perfect level and in finding its length to the minutest fraction, precautions involving the utmost niceness of instrumental construction, the utmost care and patience in observation and calculation, and repeated measurement, occupying months of time.

If the exact survey of a State or a strip of coast line is worthy of so much preliminary care and cost, how much more so is the survey of the universe! In surveying the earth, it is possible at any time to test the correctness of the work by measuring a new line and comparing its length thus found with the length obtained by calculation. In the survey of our Atlantic coast, for example, such a test line was measured on an island in Chesapeake Bay, the original base line lying on Mount Desert Island off the coast of Maine; the result proved the substantial accuracy of the entire work of triangulation covering the larger part of seven or eight States. In astronomy, there is no such ever present means of testing results and ensuring correctness. Everything hinges on the determination of the primary base line, so that any error in it inevitably vitiates the estimate made of every other astronomical distance. And still more, the dimensions and weights of all the heavenly bodies beyond the moon, not less than their distances from the earth and from each other, are determined by calculations which involve the astronomical base line as a known element. It is the foundation, in fact, of all mathematical astronomy. Hence the importance of its determination with the utmost possible accuracy.

The base line in question is the sun's distance from the earth. The measurement of this distance with all attainable exactness, and the determination of the maximum limit of unavoidable error, constitute the most important problem now engaging the attention of the astronomical world. The rare opportunity which will be afforded by the approaching transits of Venus for attacking this fundamental problem, under the most favorable conditions and with all the improvements in means and methods attained by modern science and mechanical skill, very naturally raises those phenomena to the highest rank among the astronomical occurrences of the century. They cannot pass without furnishing data for greatly reducing the known inaccuracy of the current estimate of the sun's distance, and consequently for a more correct determination of all other astronomical magnitudes. "Known inaccuracy!" some may exclaim, especially those whose ideas of heavenly bodies and spaces have been gained from ordinary text books, with their positive statements and professed preciseness. "Is not astronomy an exact science? And are not the magnitudes it deals with known with mathematical exactness?" If they were, the coming transits of Venus, instead of being scientifically the most momentous events of the age, would be matters of comparatively small account. A few astronomers might make a note of them, but they would hardly engage the attention of all the governments of the civilized world, or give occasion for costly expeditions to the remotest parts of the globe. The figures of astronomy are, and must ever be, approximations to the truth. The question is how small can the margin of error be made.

At present the limits of error, in the measurement of the line on which all other astronomical measures depend, are so far apart that sixty worlds like ours, standing side by side, would not be sufficient to fill the gap. As a consequence, there is an uncertainty of at least four thousand miles in the exactest estimate of the sun's diameter, or some hundreds of millions of cubic miles in his calculated volume; and every other magnitude beyond the moon is proportionately indeterminate.

Ten years ago the accepted figures were very much farther from the truth. For forty years, Encke's estimate of the sun's mean distance, deduced from the observations of the transit of Venus in 1761 and 1779, that is, in round numbers 95,000,000 miles, had held its ground; but so many lines of evidence converged to prove those figures too great that astronomers could not refrain from making the enormous reduction which took the general public so much by surprise about a decade ago. Noticing this astronomical change of base, Sir John Herschel wrote: "The superficial reader (one of a class too numerous) may think it strange and dis-