SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) ..... $3.00 a year
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Monthly (Established 1885) ..... 2.50 "
Scientific American Export Edition (Established 1878) ..... 3.00 "
The combined subscription rates and rates to foreign countries will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, DECEMBER 5, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

STILL ANOTHER RADIUM PUZZLE.

What is becoming of our science of chemistry? Our century-old atomic conceptions have received a rude shock; the law of the conservation of energy, to which everything in this universe was supposed to be subservient, is attacked; and now we seem to be reverting to the dream of the medieval alchemist—actually thinking of the transmutation of metals.

This, at least, is what we have come to, after the announcement made by Sir William Ramsay that radium apparently changes to helium. When he compares the resultant product of radium with helium, Sir William Ramsay is sure of his ground; for in conjunction with Lord Rayleigh he carried on a series of classic experiments which ended in the discovery of argon and helium—a discovery which deserves to be considered one of the most noteworthy achievements in chemical physics of the nineteenth century. Sir William Ramsay caught the heavy gas which radium emanates, a gas so evanescent that it disappears after a time; he found that gradually its spectrum, entirely different from any hitherto recorded, displayed the characteristic yellow line of helium. Day by day the helium line grew brighter. In a word, one element seemed to have changed to another. It is quite necessary to know how fast radium is turned into helium. As yet little that is definite has been furnished. If nothing else occurs but the changing of radium into helium, then, Prof. Ramsay figures, it will take 2,000,000 years to dissolve the gas.

Are we not perhaps on the verge of some great generalization, which will ultimately prove that just as we have many kinds of forces, all manifestations of one great force, so we may have seventy-odd elements, hitherto regarded as simple forms of matter distinct from each other, but in reality mere manifestations of but one matter? This strange, newly-discovered phenomenon certainly tends to show that one element may be changed into another. "What is this?" asked Sir William Ramsay, "but an actual case of that transmutation of one element into another in which the ancient alchemists believed when they painfully sought to change lead into gold and incidentally founded the modern science of chemistry?"

Clearly, there are more things between heaven and earth than are dreamed of in our chemical philosophy.

WIND BRACING DURING ERECTION.

The concurrence of several fatal accidents, due to the overturning by wind storms of partly-erected steel structural work in bridges and buildings, calls for a word of warning on this too-little-understood and too-much-neglected subject. We had occasion to draw attention in these columns, a few years ago, to the complete collapse of the steel structural work of a whole terminal shed on one of the new steamship piers in this city, the accident being due entirely to the carelessness or oversight of the superintendent of erection, in not placing sufficient temporary wind bracing. To the same cause must be attributed the fall of a traveler on the new Wabash Railroad bridge at Pittsburg, in which several lives were lost; the fatal accident on the Jersey Central bridge over Newark Bay; the fall of a considerable section of structural work on a New York warehouse; and the collapse of the steel work of a mill that was under construction at Chicago. The best modern construction in tall buildings makes special provision, in the way either of knee bracing or lateral ties and struts, for wind pressure; but there are scores of buildings put up, in which the skeleton frame has nothing to offer in resistance to wind pressure more than the relatively insignificant strength of the bolts and rivets with which the columns and beams are fastened together. To guard against collapse of such buildings during erection, it is customary to put in temporary ties of wire cable; and were this precaution always followed, and did the tying up advance as fast as the erection of the structural work, fatal accidents would never occur. As it is, the desire to make a record on the part of the erecting gang, or the carelessness or parsimony of the construction company, too often permits the erection to be carried to dangerous lengths before wind bracing is put in. If the weather is settled and no heavy blow should occur before a bridge is slung or the masonry of a building built in place, there will be no disaster; but too often the contractor is caught napping by a summer squall or winter gale—and another list of fatalities has to be recorded. It would be well for building inspectors and railroad engineers to exercise a more searching supervision of this most impotant feature in steel construction.

THE SIXTEEN-KNOT SAILING YACHT.

As an aftermath of the recent yachting season, there are two events which have served to stimulate the waning interest of yachtsmen in the closing months of the year; one is the offer of Emperor William of a cup for an ocean race from Sandy Hook to the eastward across the Atlantic Ocean, and the other is the remarkable speed shown by the latest of the large auxiliary sailing yachts, which are gaining such great popularity. We refer to the trial trip of the three-masted auxiliary schooner yacht "Atlantic," of which we gave an illustrated description in a special issue of some twelve months ago. This fine vessel, which measures 135 feet on the water line and 185 feet on deck, has been built for the express purpose of deep-sea cruising, and to this end she has been given the very moderate draft for a yacht of this size of 15 feet, and has been furnished with steam motive power which, on her recent trials, proved capable of driving the boat at a speed of 10½ knots an hour under steam alone. In order to try out her rigging, spars, sails, and machinery before the finishing touches were put on, the yacht was recently taken out for a cruise on Long Island Sound, during which she showed remarkable speed, and proved that the claim of her designer that she would, under favorable conditions, be capable of making 16 knots an hour, was well founded. The run in question was made between New London and Newport under sail alone. The yacht, after being delayed in harbor some little time because the wind outside was too severe for a sail-stretching spin, weighed anchor at New London, at 7:45 in the morning, to find when she was outside that the wind was still blowing at 35 miles an hour, with a strength of 40 miles in the puffs. As the wind was abeam, and the conditions favorable for a rapid run, it was decided not to return, but to push through under lower sails only; and anchor was dropped at Brenton's Cove, Newport, at 10:50 the same morning. The "Atlantic" thus covered the distance of 43 knots, from anchorage to anchorage, in three hours and five minutes. The sailing time from Race Rock to Watch Hill, a distance of 9⅛ knots, was exactly thirty-one minutes, which is equivalent to a speed of 18 knots per hour. After making corrections for a two-knot tide in the yacht's favor, she was found to have been making 16 knots an hour, an estimate that agreed very well with the ship's log, according to which she was making 16¼ knots. The tidal conditions, which favored the yacht at the start, were against it during the latter part of the run; and the calculated rate of speed, after making corrections, works out for 37 knots of the course at a trifle over 15 knots an hour.

AN ELECTROMAGNETIC THEORY OF THE AURORA BOREALIS.

In a paper previously read before the French Academy of Sciences, C. H. Nordmann showed by means of theoretical considerations that the sun must emit Hertzian waves, the intensity of which is a maximum in the regions, and at times, of greatest solar activity. From this proposition an explanation of the solar corona and its peculiarities as well as of the spectra of comets was derived. In a recent note presented to the Academy, the author tries to show that the same explanation would elucidate the nature of the aurora borealis, as well as the origin of the oscillations and disturbances of terrestial magnetism. Previous investigations have shown a close connection between the spectrum of the aurora borealis and that of the light surrounding the cathode of a tube containing oxygen and nitrogen; it is hence inferred that the aurora borealis is a cathodical phenomenon occurring in the upper exhausted atmosphere. Some special properties of the aurora borealis are explained by the well-known property of cathode rays to orientate themselves along the lines of force of a magnetic field. As regards the only difficulty left by the explication, viz., the origin of the cathodic phenomena giving rise to the aurora borealis, the author is able to resolve this question by means of the above proposition.

Tubes containing sufficiently exhausted gases will, as shown by Ebert and Wiedemann's work, become illuminated under the influence of Hertzian waves, the luminous phenomena thus produced being accurately identical with the cathode phenomena of Geissler tubes. The author therefore thinks auroræ boreales are caused by cathodical phenomena produced in the atmosphere under the action of the Hertzian waves emanating from the sun, according to the well-known property of these waves.

On this explanation, the different periods of the auroræ boreales will easily be accounted for; the fact that the greatest frequency of the auroræ coincides with the greatest frequency of sun spots is due to the greater intensity exhibited by the Hertzian wave given off from the sun during the maximum of sun spots. The undecennial period of the auroræ seems to correspond with the period of synodical rotation of the sun; this is accounted for by the fact that the regions of maximum activity of the sun performing a complete rotation in about 26 days, the aurora borealis must of necessity possess an identical period. The diurnal period of the phenomenon is equally explained by this theory: though the maximum production should correspond with the maximum of solar radiation in a given point, i. e., to the passage of the sun through the meridian, the apparent maximum of the auroræ cannot be observed until in the early hours of the evening, in accordance with experimental facts, as the brilliancy of daylight at the instant of the real maximum will hide the phenomenon.

The oscillations of the magnetic needle, as is well known, exhibit an undecennial period, closely corresponding to the period of sun spots, like that of aurora borealis. It thus seems as though the variation of terrestrial magnetism should be due to the same cause as auroræ boreales. On the other hand, it is generally presumed that the intensity of terrestrial magnetism and the variations of this intensity are in close connection with the general electric current of atmosphere, produced mainly in the upper exhausted layers of atmosphere, being relatively conductive, under the influence of the unipolar induction of vaporization. Prof. Righi has finally shown the conductivity of an exhausted gas tube to be notably augmented under the influence of Hertzian waves, the tube thus behaving like a coherer. Now the theory of the author will readily account for the undecennial period of terrestrial magnetism; at the time of the maximum of the spots, the more intense Hertzian waves of the sun will give rise to a relatively high diminution in the resistance of the upper atmosphere, resulting in an increase in the intensity of the electric currents of atmosphere, and accordingly in an increase in the intensity of terrestrial magnetism.

The accidental and instantaneous production of auroræ boreales, as well as the variations in the intensity of terrestrial magnetism, may equally be explained on the theory of the author. Many examples are known of magnetic thunder storms attended by auroræ boreales and coinciding with a violent disturbance of a solar spot, as detected by means of the spectroscope. The best instance for the truth of this theory is, however, derived from the fact observed by Young, as far back as 1883, that any considerable disturbance of the solar surface will be transmitted to our terrestrial magnetism with the speed of light. Now this is just the velocity of Hertzian waves.

ARSENIC IN HENS' EGGS.

Since M. Armand Gauthier established the fact that arsenic forms one of the elements of living organisms, the attention of scientists has been directed toward this question. Among the new researches are those of M. Gabriel Bertrand, and in a paper lately presented to the Academie des Sciences he brings out the following facts: Following his previous work upon the presence of arsenic in the organism, he thinks it logical to admit that this element, like sulphur, carbon, and phosphorus, is a constant element in the living cell. Instead of being localized in certain tissues, as Gauthier supposes, it exists, on the contrary, in all tissues. If this conclusion is true, and if arsenic is an element which is necessary to maintain existence, it should be found in the organism at all periods of life, in the cells of the embryo as well as those of the adult. It should therefore be found in the bird's egg, where the embryo is obliged to accomplish all its development without taking from the outside the smallest part of the arsenic which is needed. Accordingly he looked for arsenic in the hen's egg, and succeeded in finding it, of course in very minute quantities. The eggs were obtained from chickens raised at Paris in an inclosed space and fed since they were hatched upon wheat and *debris* of vegetables. Four parts of the egg were observed separately—the shell, the shell membrane, white, and yolk. The matter was first dried and then attacked by a mixture of nitric and sulphuric acids, which were perfectly pure and did not show a trace of arsenic. To detect the arsenic he employed the usual method of projecting a hydrogen flame against a porcelain plate, and found that all the parts of the egg contained appreciable quantities of the element, but the yolk is by far the richest. Of 1-200th milligramme which he finds on an average in a single egg, one-half or two-thirds is contained in the yolk.