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 "
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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.

The white has a much less proportion. In spite of its small weight, the membrane contains about the same quantity and sometimes more than the white. With certain eggs it was sufficient to treat 0.15 gramme of membrane (the amount contained in one egg) to obtain a clear arsenic ring. These results, which differ from those which have been obtained hitherto, have only been made possible by an especially sensitive method which he uses. They confirm the existence and the probable rôle of arsenic in all living cells, and scientists may be confident in drawing the conclusions which follow from such an important fact.

THE HEAVENS IN DECEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

The most interesting event of the past month, from the standpoint of the amateur astronomer, has undoubtedly been the appearance of two large groups of sunspots.

The first of these, which is situated some distance north of the sun's equator, must have originated about the end of September, on the far side of the sun. On October 4 the sun's rotation carried it into sight, and it was a conspicuous object, visible even to the naked eye, until it disappeared behind the western limb two weeks later. On October 31 it came round again, and on November 3 and 4 it was followed by another new group of spots, situated in the sun's southern hemisphere.

At the time of writing the first group consists of two large spots, about 30,000 and 20,000 miles in diameter, and about 80,000 miles apart, with a few smaller companions. The second group, though containing no such large spots, is more extensive, forming an irregular line fully 200,000 miles long.

It is impossible to predict just how these spots will look next month, for sunspots are short-lived affairs, and change rapidly; but both groups are so large that it is probable that they will last through at least one more rotation of the sun.

The first group should cross the sun's central meridian about December 3, and the second on the 7th or 8th, so that both of them should be visible during the first ten days of the month. If they are anything like as conspicuous as they are now, they will be easily visible with a field-glass, and perhaps even with the naked eye.

As is often the case with great sunspots, the appearance of these groups has been accompanied by great magnetic and electrical disturbances on the earth, culminating in a "magnetic storm" of unusual violence, sufficient to disturb telegraph lines all over the world, and accompanied by a brilliant auroral display.

It is now pretty well established that the aurora is due to electrical action—probably electric currents—in the extemely rarefied outer layers of our atmosphere, perhaps 100 miles high. So this, together with the deflections of the magnetic needle and the "earth currents," which affected the telegraph lines, may be regarded as parts of one great disturbance of the earth's electrical and magnetic condition. If the coincidence of such a disturbance with the appearance of a large sunspot stood alone, it would mean nothing; but dozens of such instances are known, and, what is more, the number of magnetic storms rises and falls from year to year in exactly the same fashion as the number of sunspots. The correspondence of the curves representing the two is very striking, and extends even to minor details.

It follows that the sunspots and magnetic storms must be connected in some way or other. But we do not yet know what this connection is, or how it works. It would be unsafe to assume that the visible sunspots are the cause of the magnetic storms. Both may be due to some common cause, perhaps something acting deep down inside the sun. Whatever it is that happens, it must be on an enomorus scale. The recent magnetic storm supplied energy enough to run telegraph lines several hundred miles long without batteries; and it is obvious that such lines must have taken up only an infinitesimally small fraction of the energy of the earth currents. The total expenditure of energy must have been enormous. But where this energy comes from, and how it reaches us, we do not know.

It is improbable that the observed electro-magnetic disturbances are simply inductive effects from much greater ones on the sun. Lord Kelvin has calculated the amount of energy that would have to be spent in the sun to create a typical magnetic storm on the earth in this way, and it comes out so excessively great—greater in a few hours than all the energy which the sun radiates in the ordinary way in years—that the hypothesis seems very unlikely.

It is possible that a clew to the problem may be given by the recent discoveries in electrical science, especially those which have introduced to us the new ideas of electrons and of radio-activity. But, considering the present rapid growth of the department of physics, it seems to be as likely that the explanation, if we get it, will depend upon some yet undiscovered fact, as upon those that have become known in the last few years. For the present we must simply admit that, though the connection between sunspots and magnetic storms is unquestionably real, its nature is unknown.

As for any relation between the sunspot period and other terrestrial phenomena, such as the weather, all that can be said now is that the effect, if present at all, is small, and is so much covered up by much larger variations due to other causes, that there is still much discussion among scientific men concerning its reality.

THE HEAVENS.

The most brilliant region in the starry heavens is that which now occupies the eastern and southeastern sky. At 9 P. M. on the 15th Orion is well up in the southeast. The line of his belt points upward toward Aldebaran and the Pleiades, and downward to Sirius, which, though still low, already vindicates its claim to be the brightest of the fixed stars.

To the left of these constellations lie other hardly less conspicuous groups. Procyon, a little higher up than Sirius and considerably farther north, marks the constellation Canis Minor. Gemini lies above and Auriga still higher, near the zenith. Following the Milky Way westward, we first reach Perseus and then Cassiopeia. Farther south is Andromeda, below which in the west lies Pegasus.

Aries lies on the meridian below Perseus, marked by a triangle of unequal stars. Eridanus and Cetus occupy a large area in the south without affording any conspicuous objects. The southwestern sky is equally dull except for the presence of Jupiter.

Cygnus is low in the northwest, and Lyra still lower. Cepheus is sinking on the left of the pole, Draco and Ursa Minor are below, and Ursa Major beginning to come up again on the right.

THE PLANETS.

Mercury is evening star throughout December, but is at first too near the sun to be seen. During the last part of the month he is visible low in the southwest just after dark. On the 31st he sets an hour and a half later than the sun, but he is too far south to be conspicuous.

Venus is morning star, and is very brilliant all through the month. She is in Virgo, about 4 deg. north of Spica, on the 1st, and moves eastward into Libra during the month. On the 1st she rises at about 3 A. M., but as she is moving southward, she rises later every night, and on the 31st does not appear until nearly 4 o'clock.

Mars is evening star in Sagittarius and Capricornus, and sets about three hours after the sun. On the 20th he is in conjunction with Saturn, being a little more than half a degree south of him. As the two planets do not set till 7:30 P. M., they should be easily seen.

Jupiter is evening star in Aquarius, and is the most conspicuous feature of the evening skies. On the 7th he is in quadrature with the sun, and is due south at 6 P. M.

Saturn is evening star in Capricornus, and sets about 7:30 P. M. in the middle of the month.

Uranus is in conjunction with the sun on the 18th, and is invisible.

Neptune is in opposition on the 27th. He is in the western part of Gemini, his position on the 1st being R. A. 6h. 22m. 41s., dec. 22 deg. 15 min. 33 sec. north, and on the 31st 6h. 19m. 10s., dec. 22 deg. 17 min. 22 sec. He appears in small telescopes as a greenish star of the eighth or ninth magnitude, and, in the absence of a good star-chart, can only be surely identified by his motion. It requires a large telescope to show his disk, which is only 2½ seconds of arc in apparent diameter (about 1-20 of that of Jupiter).

THE MOON.

Full moon occurs at 1 P. M. on the 4th, last quarter at 6 A. M. on the 11th, new moon at 4 P. M. on the 18th, and first quarter at 9 P. M. on the 26th. The moon is nearest us on the 7th, and most remote on the 23d. She is in conjunction with Neptune on the 6th, Venus on the 14th, Uranus on the 18th, Mercury on the 20th, Saturn and Mars on the 22d, and Jupiter on the 25th.

At 7 P. M. on the 22d the sun reaches his greatest southern declination, enters the sign of Capricorn, and, in almanac parlance, "winter commences."

Cambridge Observatory, November 6, 1903.

REPORTING BY ELECTROPHONE.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

On the occasion of the recent speech at Birmingham of the Right Hon. Joseph Chamberlain, a remarkable journalistic development was accomplished by the London Evening News, which reported the speech in London and published it complete within twelve minutes of the speaker's resuming his seat. The feat was achieved by means of the electrophone.

Birmingham is 113 miles distant from the English metropolis. In the London editorial office of the Evening News an electrophone receiving station was established, comprising twelve receivers. At the hall where the speech was delivered, just in front of the speaker, were arranged on all sides electrophone transmitters in small boxes. The wires connected thereto were switched onto the wires of the national telephone system, which were carried into the hall for this purpose. These wires led to the Birmingham post office, where they were switched through onto the trunk cable to London. At the metropolitan post office they extended to the National Telephone Company's exchange, and thence to the newspaper office.

The task of reporting the speech was carried out by ten reporters, and their work was divided into two-minute spells of reporting, subsequently reduced to one-minute intervals as the speech neared completion. That is to say, the first shorthand reporter was connected to the wires for two minutes, then gave way to the second reporter, who also had a two-minute interval, and so on with the whole of the ten men in rotation. Then while No. 2 was reporting, the first shorthand writer who had been relieved transcribed his notes and was ready for another spell of reporting after the tenth man had completed his two minutes. In this manner the whole speech was reported *verbatim et literatim*. Then as fast as the shorthand notes were transcribed they were handed to the linotype operator, and the speech was composed and made ready for printing.

To guard against risk of breakdown of the cable, two other trunk cables were held in reserve, but the first cable proved sufficiently reliable for the work.

By this enterprising development the newspaper was enabled to obtain its report and publish the newspaper more than an hour before the first complete telegraphic report was received.

Mr. Chamberlain commenced his speech at 8:10 in the evening. The first batch of copy was sent to the composing room and set at 8:22. Mr. Chamberlain sat down at 10:05; the last batch of copy was sent to the linotype operator and set at 10:20. The type was cast, printed, and on sale in the street at 10:32, and the last batch of the telegraphic report was not received until 11:37, so that the electrophone beat the telegraph by 1 hour and 5 minutes.

The speech was set up and made up into columns from end to end, even including the last passages, which were not issued in the stop-press news space. Had the stop-press column been utilized for the last passages of the speech, the paper might have been published earlier.

The enterprise was purely an experiment, but was so successful that in future the electrophone will play an important part in the report of a great speech, since it is now realized that distance does not militate against the successful operation of the instrument. The words were heard with perfect distinctness, as if the reporters were in the room in which the speech was delivered. At times, it is true, the words of the speaker were drowned in the applause of the audience, and thus escaped the reporters, but that was a contingency against which they would have had to contend had they been present in the room, unless they had been exceptionally close to the speaker. Every sound in the hall was heard with extraordinary clearness.

SCIENCE NOTES.

To detect the presence of dissolved oxygen in water, A. Kaiser makes use of a solution of ferrous sulphate in boiled water acidulated with sulphuric acid. This solution is introduced by means of a pipette into a flask filled with the water to be examined; an excess of caustic potash solution is then added, the flask stoppered and shaken. If the water be rich in oxygen, the precipitate remaining in suspension immediately becomes of a yellow color, ferric hydroxide being formed. If little oxygen be present, only a greenish precipitate of ferrous hydroxide is formed, and with water free from oxygen, the precipitate remains of a greenish-white color. Small quantities of nitrates or nitrites present do not interfere with the reaction.—Journ. Soc. Chem. Ind., after Chem. Zeit.

The hypothesis that the energy lost by radio-active bodies should be recovered in the form of gravitation energy has frequently been made, and in a recent paper Herr Seigel tries to confirm this theory by exposing a small lead sphere to Becquerel rays, when a loss in weight would be noted. As, however, these losses seem to remain within the limits of possible experimental errors, T. Forch, in a note published in the Physikalische Zeitschrift, No. 11, proceeds to test his conclusions by repeating his experiments in a somewhat modified form. It results from the author's experiments that, with the radio-active substance used, no absorption of gravitation energy exceeding 1-25,000,000 of the mass of the lead will take place. A theoretical research by G. Kucera relative to the same subject is published in the same issue of the above periodical. The theoretical considerations Seigel bases himself on are tested and his assertion criticised, that the masses acting on the lead sphere should be taken as being condensed in the centers of gravity of the chords cut out by the surface of the earth and as being proportional to their length. In order to carry out an integration on a tri-dimensional figure, tri-dimensional elements should be chosen as elements of integration. Correcting in this way Seigel's calculations will modify them considerably.—A. G.