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 Edition (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, corner Franklin Street, New York.

NEW YORK, SATURDAY, NOVEMBER 10, 1900.

THAT CENTRIFUGAL GUN AGAIN.

It would seem as though every field of engineering had its particular and perpetually recurring monstrosity, which, in spite of the ridicule that invariably greets its reappearance, seems to have a wonderfully tenacious hold on the inventor. One of the most persistent of these is the centrifugal gun, a device with which it is attempted to hurl projectiles into space in somewhat the same way as a boy throws a stone from a sling. Only a few years ago an illustration went the rounds of the press, showing a huge disk which was to be rotated at unheard-of speeds by means of a steam engine, with pulleys and belt attachment, and which carried on its periphery a series of steel shells that were to be automatically released at the critical moment, and were to start on their tangential flight with a velocity of so many thousand feet per second. Apart from the physical impossibility of making a disk which would carry holding and releasing mechanism capable of withstanding the strains due to a peripheral speed of several thousand feet per second, these would-be artillerists evidently overlooked the fact that if there should be a delay of an infinitesimal fraction of a second on the part of the releasing gear, the shell would be thrown rearwardly into the fort, the casemate or the between-decks battery, as the case might be, and the gunner "hoist with his own petard."

The centrifugal gun idea is apparently by no means dead, for a recent issue of so staid a journal as The London Times devoted about a half column to a detailed description of a gun invented by a Mr. James Judge, which is "intended for battleships, earthworks and garrison purposes," and is described as "a huge slug on a centrifugal-fire machine gun." As usual, a disk is caused to revolve at a very high speed, power being, of course, provided by the inevitable electric motor. The "bullets" are introduced into the interior of the disk at the axle and travel along curves which lead to the circumference, where they are impelled through a barrel at the modest rate of 3,000 per minute, or 50 per second. With a muzzle velocity of 2,000 feet per second, penetration was effected through a $\frac{7}{16}$ inch plate placed at a distance of 400 yards. We are informed by our contemporary that there is no excessive heating of the gun, because of the continuous stream of cold air which is impelled through the barrel by the motion of the disk. It is bad enough when a journal whose technical information is usually so correct as that of The London Times lends itself to such a piece of self-evident humbug as this; but the case is even more aggravated when a technical journal in this country, which is devoted to naval and military interests, gravely repeats the story with manifest belief in its possibilities.

AMERICAN ENGINEERING METHODS FOR THE DEVELOPMENT OF INDIA.

In a supplement to an article published in Blackwood's Magazine on the subject of irrigation in India, Major-General F. C. Cotton, of the British army, shows not only how the country will be rescued from periodical famines and enriched by the water of its great rivers, wherever that water is carried, but at the same time how irrigation will enhance the value of the railways, on which the government has expended so large a sum of money. Referring to objections raised against a former article advocating extensive irrigation works, on the ground that India is a poor country and cannot afford great expenditures, the writer says that the same objection was held some seventy years ago when engineers were urging the extension of various hydraulic works; and that as at that time it appeared to him that the engineering methods of the United States, where capital at that time was scarce, were better suited to the needs of India than the engineering methods of England, where capital was so much more abundant and more easily obtained, he determined to visit the States and study the problem on the ground. He found that the sections of the States which he visited were financially little better off than India. But although capital was scarce, and credit was at a low ebb, "the rulers were men of unlimited energy and determination, with statesmanlike views of the future."

He quotes the case of the Augusta Railway, which "was approaching completion without a cent of metal money being spent upon it. It could hardly be said that paper money was used, for the notes had no equivalent in money, but were good for so many tons carried so many miles on the railway when it was completed." While the writer disclaims any intention of quoting this fact as a precedent to be followed in India, but simply as "serving to show how difficulties are met by those remarkable people who are still acting broadly upon the same far-sighted policy" in other enterprises, "I must say," continues the General, "that I long to carry such statesmanship as I saw there to the country I love so well in the East." He attributes the terrible famines which have periodically swept the country to the lack of adequate farsightedness and enterprise, and points to the fact that while famine is raging over 440,000 square miles of India, all the great rivers are pouring their flood waters into the sea. This, he maintains, would not to-day be the case if such a policy as he found in America had been followed in India.

There is unquestionably much truth in the candid statements of this army officer. Although the case quoted of the Augusta Railway is one which would form a rather perilous precedent for the financiering of modern enterprises, there is no question that in the main the writer is correct; for although what he calls the far-sighted policy which has governed the development of the natural resources of this country has in many cases been productive of temporary disaster, there is no question that to the daring methods pursued by the early promoters the wonderfully rapid industrial growth of this country is largely due.

STEAMSHIP COMPETITION ON THE ATLANTIC.

As far as the question of speed is concerned, the development of the fast transatlantic steamship has reached a critical stage. Regarding the advisability of building high-speed vessels, there is, among the shipping men, a division of opinion. On the one hand, the British and American companies, apparently convinced that the maximum economical speed has been reached and passed, profess to be content for the future to build vessels of 20 knots or under; while, on the other hand, the German companies are continuing to bring out larger and faster vessels at a rate which was never approached in any previous period in the history of the transatlantic steamship.

The English companies, after having developed the high-speed liner to the stage represented by the "Campania" and "Lucania," boats which are clearly entitled to rank as the prototypes of the modern high-powered vessel of vast dimensions, have of late produced no fast ship of the first rank; for the "Oceanic," although unapproached in point of displacement, is of moderate speed (20 knots), and is, therefore, not to be reckoned in the present consideration. Indeed, it may be said that this vessel was a protest on the part of the White Star Company against the tendency to cram the modern liner with engines, boilers and coal in the effort to keep in the front rank of competition. Since 1893, the year of the Chicago World's Fair, the British steamship companies have apparently been content to drop out of the race, and yield to their younger competitors across the North Sea the distinction, once so highly prized among themselves, of building and operating the fastest ships in the world. Judging from the present trend of affairs, British ship-owners are drawing out of the competition altogether and are contenting themselves with the construction of less showy but, as they persistently affirm, more profitable vessels, half cargo and half passenger, of the "Ivernia" type, a sectional view of which is given elsewhere.

We should be more inclined to believe these oft-repeated assertions as to the unprofitable character of the modern express steamship, were it not for two considerations: In the first place, as the London Engineer remarks in a recent editorial, we heard very little from the English press about the dangers to the passengers and the financial loss to the shareholders entailed in running high speed vessels until the Germans made their wonderfully successful venture with the "Kaiser Wilhelm," a vessel which not only easily outdistanced her competitors, but has been a strong drawing card, to judge from the standpoint of the passenger agent, with the traveling public. In the second place, the fact that the North German Lloyd Company, after three years' experience in running an expensive vessel of this class, should have deliberately placed an order for two larger, more powerful and much more costly boats, involving an outlay of, surely, not less than $7,000,000, is to us proof positive that the "Kaiser Wilhelm," at least, has not proved a losing venture. It is true, as the English journals point out, that the German subsidies given to these vessels are liberal, but it is absurd to suppose that they are sufficiently generous to cover the deficiency on such an enormous investment of capital as will be involved in the production and maintenance of these new ships. Elsewhere in this issue we present figures that give good reason to assume that the latest and most costly of these vessels is far from being a losing venture, the full passenger lists, the high prices paid and the frequency of the round voyages, enabling the vessel to roll up a balance to her credit during the summer season that must more than offset the deficiency during the winter months, and this without taking into consideration the postal subsidies.

A most important consideration, and one to which competing companies cannot afford to shut their eyes, is the world-wide prestige which accrues to the line that can run a 23-knot boat on a 3-week schedule with something of the regularity of railroad service. The fame of such a vessel attracts a large amount of travel that otherwise would find its way through other channels. Thus, an inquiry into the statistics of a recent week's sailings from this port showed that while the American line carried 90, the White Star line 60, and the "Fuerst Bismarck" 55 first-class passengers, the "Deutschland" took out 281 in the first cabin—figures which need no comment.

While no one begrudges the credit which is due to the German companies for having figured so brilliantly in the modern development of the transatlantic steamship, we cannot but hope that the American Line will have the courage to order a couple of fast boats which will surpass all others in speed and accommodations. There is not the slightest doubt that our builders are equal to the task of constructing such ships, and judging from the success which has attended the "Lucania" and "Campania" and their successors of the German lines, we do not doubt that these vessels would be a profitable investment.

LAKE TANGANYIKA EXPLORATIONS.

An English explorer, Mr. J. E. S. More, who is one of the members of a scientific expedition sent to the lake regions of Central Africa, has recently made a report to the Geographical Society of London; one of the most important points is the rectifying of the position of Lake Tanganyika upon the existing maps. Mr. More had, in a previous expedition to this region, made a number of soundings and dredgings in the lake, and in a note presented to The Journal of Microscopical Science he shows the presence, in the waters of this lake, of a fauna of very different form from that which is typical of soft water, and including forms which are identical with those of the Jurassic earths. To complete these observations upon the fauna of the lakes and the general configuration of the region, Mr. More made a second trip, accompanied by Mr. Malcolm Fergusson, who was especially charged to study the structure of the mountains which bordered the lake and with the cartographic work. The expedition left London on April 19 of last year, and arrived at Blantyne in Nyassaland in the latter part of June, and from there passing to Zombaa, Fort Johnston and Lake Nyassa. After remaining near the lake for about one month, they came in the latter part of September to Ktiotua, at the southern end of Lake Tanganyika. Mr. Fergusson has taken by astronomical observations the exact situation of a certain number of points situated on both banks of the lake, Soumbou, Loukega, and two others on the west bank and Msamba, Oujiji and five others on the east bank. The sketch which has been established from these co-ordinates shows that if the southern part of the lake, from Soumbou to Ktiouta, remain fixed, as also the beginning of the eastern and western sides, the axis of the lake, and in consequence the whole ensemble of the basin, should be carried considerably to the east. On the other hand, the outline given to the lake at the present time does not appear to be modified appreciably. It is toward the central part of the lake that the greatest differences from the admitted position appear. This position has been determined from measurements made by Capt. E. C. Hore, combined with the longitude of Oujiji as found by Lieut. Cameron. It is the latter explorer who traversed the region in 1874–75 and was the first to give an exact idea as to the hydrographic system of the lake. His observations agreed with the opinion of Livingstone, who supposed that the lake emptied into the River Loualaba. Cameron was the first to establish with certainty that it belonged to the basin of the Congo, by the discovery he made of the River Loukouga, which proceeds from the west bank of the lake. It is an affluent of the Loualaba-Congo, but it is only an intermittent outlet of the lake, as it is sometimes obstructed by a dam of sand and débris which stops the outflow of the lake and causes its level to rise. This explorer fixed the longitude of Oujiji at 29° 59′ 30″ east, by lunar observations, which comes close to the figures recently obtained.

The present expedition visited the mouth of the Loukouga where it joins the lake; the mountains, which are very high along the western coast, decrease gradually from Mtova, on the right bank of the river, toward the north, and also from Temboni to the southern extremity of the lake. The entrance of the Loukouga forms a kind of delta of sand, where the water flows in several small streams which unite about a mile from the lake to form the river; this flows between banks of soft and sandy earth, 50 to 100 feet high. The mountains, which are lower to the north of the river, increase in height near Ouvira, to the northwest of the lake; they reach a height which Mr. Fergusson estimated to be 8,000 feet. These mountains form a range parallel to those of the northeastern side, whose height is also quite considerable. From Lake Tanganyika Messrs. More and Fergusson proceeded to Lake Kivou, which was first seen in 1894 by the German Lieutenant Von Goetzen. Mr. Sharpe and the German Doctor Kandt, who have recently explored that region, say that the position of Lake Kivou is very badly laid out on the maps. The present explorers climbed the volcano of Karounga, which is in activity; it lies on the north bank of the lake. They proceeded then to Lake Albert Edward, and arrived about the middle of February at Fort Gerry, having decided to make the ascension of Mount Rouenzori, which has an altitude of 17,600 feet. It is the principal peak of the mountainous region which rises between the Lakes Albert and Albert Edward.

CATHODE RAYS.*

BY P. VILLARD.

The passage of the electric discharge in gases produces luminescent phenomena easily observable at pressures of the order of one millimeter of mercury. In a tube provided with electrodes the discharge gives the following appearance. A violet-red luminous column starts from the positive toward the negative electrode, but stops before reaching the latter, ending at the dark space of Faraday. It is deflected by a magnetic field; as the pressure is reduced, the column increases in volume, but becomes more feeble and disappears. On the contrary, the luminosity at the negative electrode envelops all or part of the electrode, being violet in color (yellow in oxygen, pink in hydrogen). As the rarefaction increases, it enlarges and covers all the surface, increasing in thickness; at the exterior it ends at the dark space and at the interior it is separated from the cathode by an equipotential surface, the interior space being relatively dark. In immediate contact with the cathode is a layer of pinkish light, visible only at high vacua.

ELECTRIC RESISTANCE OF DISCHARGE TUBES.—The gaseous medium is not to be compared with a conductor; the current passing in it is discontinuous and not regulated by Ohm's law. It is not comparable to an electrolyte. The law connecting the current intensity with the difference of potential is not known exactly, but below a certain tension the gas acts as a perfect dielectri , while above that point a discharge is produced and the current increases with the tension; 300 volts is the minimum for the discharge.

BEAM OF CATHODE RAYS.—In a spherical or ovoid bulb provided with a cathode in the form of a concave mirror, the negative light is voluminous and fills the bulb, the dark space extending a few millimeters from the cathode, and a luminous cone is formed, which becomes more distinct as the vacuum increases. The cone is the trace of the beam of cathode rays in the residual gas; scarcely visible in the dark space, it becomes brilliant farther out; its color is violet in air, pale yellow in oxygen. As the vacuum is increased, the cone changes to a cylindrical beam starting from the center of the cathode. The cathode rays are propagated in straight lines, and cross without interference.

PHENOMENA OF PHOSPHORESCENCE, ETC.—M. Villard points out the well-known effects produced upon the different bodies, especially the alkaline earths and phosphorescent screens, and recalls their propagation in straight lines, as demonstrated by the shadows cast by bodies placed in the path. The mechanical effects of the rays are shown in turning radiometer vanes, etc. The calorific effects are strongly marked; according to the action produced upon a fragment of diamond, M. Moissan estimates that the temperature thus reached 3,600° C. An object encountered by the rays becomes a source of Roentgen rays. As to the chemical effects, M. Goldstein has discovered that the haloid alkaline salts become colored and their phosphorescence diminishes; chloride of sodium becomes brown, and bromide of potassium blue; the colors disappear slowly in the dark and rapidly in the light. Messrs. Wiedemann and Schmidt have found that the salt acted upon has an alkaline reaction; Messrs. Elster and Geitel find that they possess the photoelectric property in a great degree, and part with a negative charge under the action of violet light. These reactions indicate a reducing action on the part of the rays. If the shade of an obstacle is projected upon a sheet of copper oxidized at the surface, the copper is here reduced to the metallic state. When the rays encounter the air, ozone is produced, as M. Lenard has shown.

The deviation of the rays by the magnet is well known; the deviation diminishes with the pressure, or as the tension rises. Its direction is determined by the laws of charged bodies. M. Villard shows the calculation of this deviation, which has been made by Mr. J. J. Thomson. If e is the charge, m the mass, and if the speed, v, is small compared with that of light, the calculation shows that $\frac{e}{m}$ is a constant and independent of the nature of the gas.

ELECTROSTATIC DEVIATION OF CATHODE RAYS.—The enlargement of the shadow of a wire united to the cathode or to the ground has been observed from the beginning by Mr. Crookes and others, but the question has only recently been made clear by the experiments of M. Majorana and M. J. Perrin. A beam of parallel rays traverses an anode of wire gauze and casts the shadow of a wire upon the walls. A static machine has one pole joined to the gauze and the other to the wire; when the wire is charged negatively, the two half-rays which it forms are separated, enlarging the shadow; a positive charge brings them together, and they may even cross, showing them to be attracted by a positive and repelled by a negative charge. Two beams of cathode rays have no reciprocal action upon each other, as has been shown by Wiedemann and Ebert, Bernstein and the author. The absence of mutual action does not imply absence of electrification; it suffices to admit that the particles in movement follow each other at distances which are great compared with their radius of action.

The fact that the rays are propagated in straight lines shows that even near the anode the electric field is too weak to have a sensible action upon them. Experiments show that the field is very intense near the cathode, but very weak in the rest of the tube. As to the speed of cathode rays, the attempts at direct measurement made by Mr. J. J. Thomson and M. Majorana have not been conclusive. Mr. Thomson has made a series of calculations by an indirect method. If m is the mass of the particle, e its charge and v its velocity, the result of the calculation shows that the value of $\frac{m}{e}$ varies from $1{\cdot}1 \times 10^{-7}$ to $1{\cdot}5 \times 10^{-7}$; and that it is independent of the nature of the gas. The value of v lies between $2{\cdot}2 \times 10^{9}$ and $3{\cdot}6 \times 10^{9}$ centimeters per second. M. Wiechert has determined the velocity by a direct method, and finds the value of v between $5{\cdot}04 \times 10^{9}$ and $3{\cdot}96 \times 10^{9}$ centimeters per second. It is thus of the order of one-tenth the speed of light.

ELECTRIC AND MAGNETIC DISPERSION.—M. Birkeland has shown that a cathodic beam may be decomposed by a magnetic field into several distinct beams unequally deviated. This experiment, made with a beam passed through a slit and a magnetic field parallel to the slit, gives upon a fluorescent screen a veritable cathodic spectrum. The number of rays is variable with the conditions of experiment. M. Deslandres has formed a spectrum with an electrostatic field placed perpendicular to the slit. It is found that these beams unequally deviated correspond to different potentials, and they must, therefore, be emitted successively.

The experiments of M. Lenard are of great interest. He has studied the rays outside of the tube; for this he uses a tube whose end is formed of a thin sheet of aluminium. The rays passing outside are soon diffused in air, but in a rarefied gas he obtained a cone of rays three feet long. M. Lenard shows that the rays render the air a conductor of electricity, provoke the condensation of supersaturated vapor and ozonize the air.

SECONDARY EMISSIONS.—M. Goldstein has observed that if a tube has narrow places or elbows, these emit cathode rays at the side of the anode. When a perforated paper screen is placed between the anode and cathode, each hole becomes a center of emission. An isolated metallic sheet, struck by the rays, emits secondary rays, which are always perpendicular to the surface.

PASSAGE OF THE RAYS THROUGH METALLIC SHEETS.—Hertz has shown that very thin metallic sheets allow the rays to pass. According to Lenard, glass 0·2 millimeter thick is also traversed. Mr. J. J. Thomson and the author consider that the transmission is not real, but that secondary rays are emitted. Another series of experiments have been made by M. Goldstein. If a tube is divided into two parts by a cathode having several openings, beams resembling cathodic beams are observed in the part of the tube opposite the side of the anode, these leaving from each of the openings in the cathode. These new rays have been given the name of "Kanalstrahlen" by the experimenter; they are peculiar in not being deviated by an electric or magnetic field.

NON-DEVIABLE RAYS.—Mr. J. J. Thomson has found that only a part of the cathode rays are deflected by the magnet. If the vacuum is such that the rays start only from the center of the cathode and are visible by the illumination of the residual gases, it suffices to approach a magnet to show that a part of the beam is unacted upon and continues in a straight line. These rays illuminate the residual gases, but seem to have no action upon phosphorescent bodies.

NATURE OF THE RADIANT MATTER.—The phenomena of reduction already pointed out with many chemical compounds is obtained either by the cathode rays or the "Kanalstrahlen." If at the same time it is remarked that the cathodic phenomena are independent of the nature of the gas and that the relation $\frac{e}{m}$ is invariable, one is brought to admit the unity of the radiant matter. Hydrogen, however, is the only simple gas known which has a reducing action, and it is precisely this gas whose spectrum is always and often alone visible in the cathode layer. This element has special properties, such as the power to traverse metals heated to redness. While waiting for another simple reducing gas to be discovered, the hypothesis may be considered as acceptable that hydrogen constitutes the radiant matter.

* Lecture delivered before the Congress of Electricity, Paris Exposition. Abstract prepared by special Paris correspondent of the SCIENTIFIC AMERICAN.

PURIFICATION OF GASES.

In the course of a lecture delivered before the English Institution of Civil Engineers, Dr. C. H. Wedding described the purification of noxious gases at the Kotterbach iron mines in Upper Bohemia. The ores obtained in this locality are richly impregnated with carbonates, and they are roasted before their conveyance to the blast furnaces, for the purpose of liberating the carbonic acid. By this means, an economy approaching 33 per cent is effected in the cost of freightage. This district, in addition to being a rich iron mining center, is also a profitable agricultural country. In fact, agriculture is quite as important as the iron mining. It was discovered that the driving off of the sulphurous and mercurial vapors during the roasting was detrimental to the welfare of both the animal and vegetable life in the vicinity. An attempt was thereupon made for the purpose of purifying the noxious fumes before their dissolution in the atmosphere, and a condensing plant was installed. Two timber towers, each three stories in height, have been erected. The floors of the buildings are thickly set with blocks of limestone. At the summit of each tower is placed a large tank of water, from which a steady spray, equal in area to the whole surface of the floor, is constantly running. The gases upon their exodus from the ores in the roasting process are conveyed to the bottom of the first tower, and ascend against the stream of water through the floors to the top of the building. The cool spray deprives the gases of their mercury and compounds, and arsenic and antimony compounds, also a portion of the sulphur oxides. That part of the sulphur oxide which is not freed from the gases by the water displaces the carbon dioxide of the limestone, forming sulphites and sulphates of lime. The gases in their semi-purified condition are conveyed from the top of the first tower to the bottom of the second structure, and the process repeated, after which they escape into the air, and have been found in this purified state to have no effect upon either the cattle or crops. The cost of running this condensing plant is defrayed by the recovery of the mercury, which is collected in settling ponds, purified, and sold.

DEATH OF MAX MÜLLER.

Prof. Friedrich Maximilian Müller, Corpus Professor of Comparative Philology at Oxford University, died October 28. He was born in Dessau, Germany, in 1823, and after attending the universities at Leipzig and Berlin received his degree in 1843. He early showed a great fondness for philology and the languages of the East. He studied Arabic, Persian and Sanskrit, and visited several countries to study manuscripts. In 1848 he settled at Oxford. His rise in the university was rapid, and he was elected a Fellow of All Souls College in 1858. The university intrusted to him the editing of a series of translations of the sacred books of the East and fifty volumes have been issued. He published a large number of the most important works and papers upon Oriental languages, and he received many honors from foreign universities and courts. To some extent he outlived his reputation, and he held a much higher place in the estimation of British scholars a quarter of a century ago than he held in recent years.

The theory with which he is most closely associated in the public mind is that the cradle of the Aryan languages must be looked for in Central Asia; this view no longer commends itself to most students of the subject.

OYSTERS IN EUROPE.

Vice Consul-General Hanauer writes from Frankfort under the date September 22, 1900:

The French naval department has an exhibit in the Paris Exposition giving a graphic view of the development of oyster cultivation in France. During 1879–1887, the yearly average production of French oysters amounted to 11,000,000 francs ($2,123,000), gradually increasing to 20,500,000 francs ($4,825,000) for the year 1898, when 15,500,000 French and 3,000,000 Portuguese oysters were sold along the French coasts. The bivalves are a great luxury in Europe, and so dear that only the wealthier classes can afford to eat them. In the city of Frankfort, small German or Dutch oysters in the shell cost from 60 to 72 cents (2½ to 3 marks) per dozen. Some resident Americans occasionally have a barrel of American oysters sent by their friends at home. The shipment of our oysters in cold storage would be practicable and afford profit.