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 "
American Homes and Gardens ..... 3.00 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, SEPTEMBER 16, 1905.

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.

PLANNING THE PANAMA CANAL.

The Board of Expert Engineers, gathered from many parts of the world, that recently met in Washington on request of President Roosevelt, to decide upon the best type of canal to build at the Isthmus of Panama, has before it what is probably the most momentous question of a strictly engineering character that was ever passed upon in the history of the world. Upon its decision will depend the time of completion, the cost, the character, and very largely the commercial success of this great enterprise. The Board will have placed before it an enormous amount of engineering data that has been gathered through the several decades in which work has been done, either in the way of surveys or construction, upon the forty-two-mile stretch of country on which the canal is located. The mere engineering data, such as surveys, borings, topographical work, meteorological and geological observations, in themselves form a most voluminous record. These constitute the facts as distinguished from the theories, and it is upon the facts, after all, that the final plans must be built up and the final decision based. In addition to these ascertained facts, however, the advisory board will have placed before it many alternative plans, the most important, because the most complete, of which is that one drawn up by the late French Panama Canal Company and indorsed by the International Commission of Engineers. There will also be the amended plans, as favored by the Isthmian Canal Commission; the apparently somewhat hasty and ill-digested plans of the late Chief Engineer Wallace for a sea-level canal; the proposals of Mr. Bunau-Varilla, the Chief Engineer of the late French Panama Company, for the construction, at an early date, of a canal with a high summit level, with arrangements for its gradual conversion during operation into a sea-level canal. Furthermore, there is the important study of the subject which was recently defined in a pamphlet prepared by Lindon W. Bates, which proposes to create large navigable basins at each end of the canal, and to convert considerable areas of mosquito-infested and malarial swamp into fresh-water lakes.

In a letter read at the first meeting of the Board, Chairman Shonts stated that this system of presenting the subject by offering several alternative plans had been adopted, because it seemed to be the method by which all essential information could be conveyed in the most condensed form possible. He stated further that the Commission desired the opinion of the International Board not only upon these plans, but upon any variation of them, or upon any entirely different plan that might suggest itself. During the last of this month the Board will accompany the Commission to the Isthmus of Panama, to make a personal inspection of the work.

FILTRATION FOR CROTON WATER.

That filtration of the city's water supply is one of the surest means of preventing typhoid fever and kindred diseases, has been proved in every case in which filtration plants have been built and put in operation. In recent years the SCIENTIFIC AMERICAN has given much attention to the question of water supply filtration, and the records, as far as they have appeared in these columns, go to prove that of all municipal improvements, this is one of the most beneficent and immediate in the betterment of the health of the inhabitants.

The question has recently been placed before the Mayor in a letter from Dr. Darlington, the Health Commissioner of this city. He points out the impossibility of safeguarding the sources of city water supply by the absolute prevention of infection of the watershed from which the supply is drawn. As regards the Croton watershed, the region is to some extent settled already, and there are various scattered centers of population which are showing evidence of rapid growth. It has been suggested that the city might furnish these localities with sewers and pumping stations; but the cost of doing work of this kind in the thorough manner that would be necessary to make it effective would be prohibitive. Moreover, Dr. Darlington is of the opinion that complete ownership by the city of the land would not be a sure guarantee against pollution. Outside of the provision of sewers and pumping stations, or the outright purchase of the land, there is the third alternative of filtration; and it is this that the Commissioner strongly recommends. It is estimated that the first cost of sand filter beds, of a size adequate to deal with the present needs of the city, would be $17,000,000; and for this sum it would be possible to pass the whole of the supply that is now drawn from the Croton watershed through slow filtration beds, with the result that the risk of the introduction of typhoid and kindred diseases through the medium of our water supply would be practically eliminated.

Evidence of the inestimable value of filtration as a preventive of disease is afforded by the charts which accompany the Commissioner's letter. These show, in the case of Philadelphia, the low rate of typhoid fever in districts using filtered water as compared with those using water not so treated. In one district, which depended upon unfiltered water from the Delaware, the typhoid rate was high and showed wide fluctuation. In two other districts of the same city, which were supplied with water from the Schuylkill that had been passed through filter beds, a low average typhoid rate was shown, and this low rate remained practically uniform. Of the two systems of filtration that would be applicable for New York city, one employs pressure and the other depends upon gravity, the former being used where but little land is available for the filter plant, and the gravity system being used where an ample area can be obtained. In the latter system, which is the more common, water is allowed to find its way by gravity through broad, shallow beds of sand, and a considerable part of the purification is due to "beneficent" bacteria. Among the many municipal improvements that are being suggested just now for the betterment of New York city, we know of none that is deserving of more serious consideration by the authorities than this.

OUR RAILROAD SYSTEM.

Despite its vast proportions, the railroad system of the United States continues to maintain its rapid rate of growth, and the last report of the Interstate Commerce Commission shows that there are at present no indications of any such stagnation as marked the year 1893-1894. The growth is a steady and a healthy one. The total single-track railway mileage has risen to 213,904 miles, an increase during the year of 5,927 miles. These figures and those that follow represent no less than 2,104 separate railway corporations. In the service of the railways there are 46,743 locomotives, an increase of 2,872. The total number of cars is 1,798,561, an increase during the year of 45,172. Of this total, 39,752 are passenger cars, 1,692,194 freight cars, and the remainder are employed in the special service of the railroads. The work of equipping the rolling stock with train brakes and automatic couplers is in a satisfactory condition, as out of a total of over 1,800,000 locomotives and cars, over one and a half million are fitted with train brakes, and over 1,800,000 are fitted with automatic couplers. The par value of the amount of railway capital outstanding is $13,213,-124,679, which represents a capitalization of $64,265 per mile.

During the year the number of passengers carried was 715,419,682, an increase of 20,528,147, and the number of tons of freight carried was 1,309,899,165, an increase of five and a half million in the year. The net earnings of the railways amounted to $636,277,838, a decrease of $7,030,217. The amount of dividends declared during the year amounted to $222,056,595. The total number of casualties to persons on the railways for the year was 94,201, of which 10,046 represented the number of persons killed, and 84,155 the number injured. Of trainmen, 2,114 were killed and 29,275 were injured. Of switch tenders, crossing tenders, and watchmen, 229 were killed and 2,070 were injured; while of other employes, 1,289 were killed and 35,722 injured. The number of passengers killed in the course of the year was 441, and 9,111 were injured. Of these, 262 passengers were killed and 4,978 were injured in collisions and derailments. When these statistics tell us that the ratio of casualties indicates that one employe in every 357 was killed, and one in every 19 was injured, we begin to realize how serious are the risks run by those who maintain our great railroad system in constant operation. The risk to life and limb of the trainmen surely has its parallel nowhere outside of the battlefield; for we learn that in the particular year under consideration, one trainman was killed for every 120 employed, and one out of every nine was injured. This proportion of casualties, as a matter of fact, is just about one-half as great as that of the whole Japanese army during the recent war.

THE PROGRESS OF WIRELESS TELEGRAPHY IN GREAT BRITAIN.

The British government has recently issued the first annual report concerning the development of wireless telegraphy in that country during the first year since the passing of the Wireless Telegraphy Act. According to this regulation, it was made illegal to work or exploit, either commercially or experimentally, any system of ethereal communication without the sanction of the Postmaster-General. During the past twelve months, 73 applications for working wireless telegraph systems have been received. Of this number, 48 have been granted, 4 have been returned to their applicants for modification, as permissions were refused in the original form, 1 has been rejected in its entirety, while the remainder have not been proceeded with.

The solitary complete rejection is in connection with the Orling-Armstrong system. The reason for its refusal by the government was because the company controlling the patents proposed to establish wireless exchanges. Such a system would have interfered with the ordinary telegraphic business of the Post Office, which is a government monopoly. The act, however, as the report shows, is being liberally administered, and the government supervision that is being exercised cannot do else but tend to develop the system of communication, at the same time preventing any one system obtaining a monopoly either by unfair competition or merging processes. The report also shows the number of various systems that have been advanced to a practical stage, and that the Marconi system is by no means the only commercial and practical one. As a matter of fact, of the 73 applications received, only three concern the Marconi apparatus, and of these three licenses, one is purely for experimental purposes. The two other permissions extend to the Marconi company itself, and to Lloyd's, which is under contract to the Marconi company for the exclusive application of that system. These, however, are the only two companies that are exploiting the scheme upon a commercial basis in accepting wireless telegrams from the public; but the report shows that other principles are on the eve of commercial exploitation, or are being privately employed for business purposes.

The variety of the apparatus in vogue may be gathered from the fact that the Eastern Telegraph Company—a cable concern—are utilizing the Maskelyne system for communication between their cable station at Porthcurnow in Cornwall and their cable-repairing ships; the London, Brighton, and South Coast Railroad are adopting the instruments of the French inventor Rochefort for linking up their station at Newhaven with the French port Dieppe, on the opposite side of the English Channel; the Midland Railroad are installing the Lodge-Muirhead system, for communication across the Irish Channel between Belfast and Heysham; while two American companies, the De Forrest and Fessenden, have been granted licenses for the erection of stations in Scotland.

The Midland Railroad is also carrying out a series of experiments with the Lodge-Muirhead system for communication with trains in motion from a point near Derby, as has already been done in this country and Germany. The Marconi, De Forrest, and Fessenden companies have been granted permission for the development of communication between Great Britain and America. For this work the Marconi company intend to utilize the station at Poldhu in Cornwall, while they have also applied for permission to erect another similar station in Ireland for the same object, but this application has not yet been granted. The experiments of the two American companies will be conducted from the stations which they are erecting in Scotland. The De Forrest company also desires to establish a series of stations around the British coast, while the Lodge-Muirhead company has also applied for licenses at four important stations from a shipping point of view —Dover, the Isle of Wight, the Lizard, and the Fastnet.

During the first three months of this year, the British Post Office received 111 messages from the public for transmission to ships at sea *via* Marconi, in accordance with their agreement. Of this total, 21 messages failed to reach their destination. The incoming messages—from ships at sea for transmission to interior land post offices—aggregated 1,655 for the same period. The revenue from this source of traffic averages about $12,000 per annum. There are, however, only six shore stations and fifty ships at present replete with the Marconi apparatus, and it is recognized that the number will have to be considerably increased before the scheme can become profitable.

There is, however, every sign that wireless telegraphic communication has successfully emerged from its experimental stage, and can be extensively developed commercially. At present, however, progress is somewhat slow, owing to the high tariffs levied for the transmission of messages by this means; and until the fees are reduced so as to compare favorably with the ordinary telegraphic system, it will not become of the importance to the maritime and commercial community that its value deserves. It is anticipated, how-

ever, that the healthy competition between the various systems established by the British government's action will achieve this end.

THE BUOYANCY OF SUBMARINE BOATS.

In view of the tragic interest attaching to the recent submarine disasters, the following explanation of the loss of submarine "A8," given by a submarine expert during the investigation by the British Admiralty, commands special attention. The "A8" while traveling on the surface in a calm sea, it will be remembered, suddenly plunged down, and sank with fourteen of the crew.

According to Capt. Bacon, in the ordinary conditions the buoyancy of the submarine was reduced until only about 800 pounds remained, the boat being sunk until only approximately two feet remained well out of the water. In that condition the boat would dive if the horizontal rudders were put down, the nose of the boat depressed, and the speed of 6½ knots maintained. But if the buoyancy of the boat were increased to about 1,120 pounds, and she was still kept trimmed horizontally, the boat could not be made to dive. Before that happened and the boat could be forced under, her tail must rise to the surface. In such a case the propellers and rudders would no longer be immersed, and in consequence the boat would be unable to break away from the surface. If, however, she were trimmed suitably, two or three degrees by the bow, diving could be carried out. The "A8" had 13,440 pounds of buoyancy instead of 1,120 pounds, and was going 10 knots instead of 6 knots. The causes of her diving were therefore not clear. Allowing for the difference of 6½ and 10 knots, and supposing, as was probably true, that all the pressures varied as the square of the speed, the effect of speed would be only as 100 is to 42 buoyancy and one degree by the bow. If the boat steamed ahead and sank, the boat had a tendency to go more and more by the bow, and to steam herself under water. Imagine the boat to be immersed until her hull was nearly covered, whichever way the rudders were put, the conning tower would probably go under water, for the down pressure of the rudders would reduce the buoyancy more than that given her by the conning tower.

Taking for granted that a boat in this condition could be dived at 10 knots, the question was, how could the condition of the boat be changed from one of 13,440 pounds buoyancy and four degrees by the stern to one of 7,840 pounds and one degree by the bow? The only explanation was by water finding its way into the tanks forward in the boat. The two tanks into which the water could possibly get were the foremost main ballast tank and the foremost gasoline tank. If 5,660 pounds of water found its way into these, the buoyancy of the boat would be reduced to 7,840 pounds, and the moment of 75 tons would be introduced, tending to put her down by the nose. This would mean an inclination of 2½ degrees by the bow. Steaming ahead would probably bring her down another two degrees by the bow. The only other weights that could move were the men. There were six men stationed in the boat who were liable to move. Had these gone forward after the boat started steaming, as was usually the case, and sat down by the torpedo tubes, they would have produced a moment of about 12 foot-tons, or an inclination at 7,840 pounds displacement of one degree.

RAMSAY, RADIUM, AND BURKE.

In a well-considered and frankly skeptical and sensible article published in the Independent, Sir William Ramsay has this to say anent Burke's "radiobes":

"During the decomposition of the emanation into helium and other products much heat is evolved, as was shown by Prof. Rutherford; it had been shown before by the Curies that radium continually gives off heat, and Rutherford proved that by far the major part of the heat was due to the spontaneous change undergone by the emanation. Now this energy need not all be manifested as heat; some, at least, may appear as chemical action. A solution of the emanation in water decomposes the water in which it is dissolved into its constituent gases, oxygen and hydrogen. And the rate at which the water is decomposed keeps pace with the rate at which the emanation changes—that is, at the beginning, when the emanation is fresh and there is comparatively much present, the amount of gases evolved is comparatively great; and as the emanation diminishes so the decomposition decreases, less gas being produced in a given time,

"The solution of this gas in water has the curious property of coagulating white of egg or albumen. What is the precise nature of the change produced is unknown. Hence if kept in a liquid containing albumen it forms, no doubt, ultra-microscopic cells, for the gas produced is liberated in molecules, or, it may be, even in atoms. Some solution, injected under the skin of a living being, surrounds itself with a sack, or bag, the walls of which are thick and hard and are absorbed only slowly by the living organism. These phenomena require further study, and I regret to say that I have not had an opportunity of examining them more thoroughly, though I hope to do so.

"Mr. Burke made use of solid radium bromide in fine powder. He sprinkled a few minute grains on a gelatine broth medium, possibly somewhat soft, so that the granules would sink slowly below the surface. Once there they would dissolve in and decompose the water, liberating oxygen and hydrogen, together with emanations, which would remain mixed with these gases. The gases would form minute bubbles, probably of microscopic dimensions, and the coagulating action of the emanation on the albumen of the liquor would surround each with a skin, so that the product would appear like a cell; its contents, however, would be gas, or, rather, a mixture of the gases oxygen and hydrogen. The emanation, inclosed in such a sack, would still decompose water, for enough would diffuse through the walls of the sack, which, moreover, would naturally be moist. The accumulation of more gas would almost certainly burst the walls of the cell, and almost equally certainly in one or two places. Through the cracks more gas would issue, carrying with it the emanation, and with it the property of coagulating the walls of a fresh cell. The result of the original bubble would resemble a yeast cell, and the second cell a bud, or perhaps more than one, if the original cell happened to burst. This process would necessarily be repeated as long as the radium continued to evolve emanation, which would be for the best part of a thousand years. The 'life,' therefore, would be a long one, and the 'budding' would impress itself on an observer as equally continuous with that of a living organism."

LOST ARTS.

Not as much as we used to, but occasionally even yet, one hears of some wonder accomplished by the ancients which cannot be done now.

Not so many years ago it was quite commonly asserted that modern workmen could not quarry, or, having quarried, could not handle stones as large as the monoliths of Egypt; and the writer has heard a public speaker of note assert that it would be impossible to handle, with modern implements, such large stones as were used in the pyramids, or to join them as perfectly as they are joined there; yet, when occasion arose, larger stones than any of these were quarried in Maine, and some of the larger monoliths themselves were transported, not only to the sea, but across it, and erected in England, France, and America; and there are individuals to-day who might, if they chose, cause the transportation to and erection in this country of the largest pyramids, or build new ones ten times larger and more durable. Pyramids are not being generally built, nowadays, because they are not in line with the trend of modern ambition; that's all.

It is very doubtful if a "Damascus blade" would stand half as severe usage as a modern band-saw blade, or even as much as the spring of a forty-cent clock; while the ornamentation of those wondrous blades, so far as the mechanical execution is concerned, can be excelled by apprentices and amateurs of to-day.

Of the "lost art" of hardening copper little is heard of late years, though one occasionally hears a wiseling from the wilds wish that he knew how to do it as well as the ancients; and, while it is perhaps regrettable that he doesn't, his ignorance is his own fault.

Many arts and devices have been abandoned because new knowledge has made them useless, and time spent in rediscovering them would be worse than wasted. The modern youth had much better spend his time studying the art of his contemporaries than that which is "lost."

THE CURRENT SUPPLEMENT.

The Truckee-Carson reclamation project, which will convert 30,000 acres of parched land in Nevada into luxuriant verdure, is fully described by Enos Brown in the opening article of the current SUPPLEMENT, No. 1550. William Barclay Parsons presents his views on rapid transit in great cities. Inasmuch as he was the engineer who gave us New York's Subway, his observations are of considerable importance. The report of the Royal Commission on coal supply has made it clear that in the future England will have to generate power by other means than from coal if she is to keep her place as a manufacturing nation. In a well-considered article Mr. James Saunders shows how tides could be made to turn factory wheels. T. P. E. Butt discourses interestingly on the induction motor as a generator. Mr. Warren R. Smith gives some excellent directions for a number of experiments with dyes. The Plauen viaduct, known locally as the Syrathal viaduct, because it bridges the valley of the Syra, was finally completed during the early part of this year. It comprises the largest arch masonry ring in the world, measuring, as it does, 295 feet 3 inches between the abutments. This stupendous work is very fully described by our English correspondent. Sir William White presents another installment of his treatise on submarines. An article on Sakhalin gives a very detailed account of the island which proved such a bone of contention between the Russian and Japanese plenipotentiaries. Prof. E. P. Schoch presents a thoughtful paper on the physical notions of entropy and free energy and their importance in general chemistry.

SCIENCE NOTES.

The pedagogical dictum, "from the concrete to the abstract," finds universal acceptance in this age of laboratory education. The idea of teaching through hand and eye in manual training is being put into practice more and more, owing to the great success that has been achieved by the pioneer institutions in this line. Why should not the same principles of coordinate activity govern in the teaching of algebra? Can we not clear up some of the most troublesome points by making visual, concrete representations of negative numbers, and of equations?

After covering an ebonite dish containing 0.03 gramme of radium bromide with an aluminium plate 0.1 millimeter in thickness, M. N. Orloff has noticed on the surface of the aluminium turned toward the radium protuberances similar to small drops of melted metal, but not differing in appearance from that of the neighboring surface of aluminium. These protuberances are radio-active and produce a photographic image through black paper in a few minutes. They appear to have emitted invisible radiations during a period of six months without noticeable abatement. The inference is that there is a formation of a stable alloy, due to the accumulation of particles proceeding from the atomic system of the radium around slight nuclei of aluminium.

The Chemiker Zeitung describes the researches of Dr. H. Thorns on the obnoxious products of tobacco smoke, nicotine, and its products of decomposition, ammonia, methylamine, pyrrol, hydrogen sulphide, cyanhydric acid, butyric acid, carbonic acid, carbon oxide, watery vapor, pyrogenous essential oil, tarry and resinous products, among which the presence of a small quantity of phenol has been ascertained. He recommends the filtration of the smoke through cotton soaked in ferric salts. The preparation is obtained by dissolving one part ammoniacal sulphate of iron in four parts of distilled water and 1-10 to 1-5 of a part of glycerine, soaking of the wadding and its desiccation, which ought to leave 50 per cent of the salt. By this process the fumes of the essential oil, of the hydrogen sulphide, the cyanhydric acid and about half of the nicotine and its products of decomposition, as well as the greater part of ammonia, are got rid of, while not depriving the smoke of its aroma.

A Unique Process of Irrigation.—The Italian professor, Cusmano, has originated a process which assures an ample supply of water to plants growing in regions where the dry season is of long duration. Use is made of the Barbary nopal, the *Opuntia vulgaris*, a fig tree which is widely acclimated and bears figs that are excellent reservoirs of moisture. In spring a ditch, 30 centimeters deep and about 2 meters in diameter, is dug at the foot of the tree that is to be protected from the drought. This ditch is filled with the figs cut into pieces about two fingers thick; to make a dense layer, they are beaten down and stems are added as the mass piles up. This mucilaginous pulp, covered with a layer of earth, stores up much water and gives it out gradually, thus watering the tree a long time. Prof. Cusmano asserts that after four months of drought he has found pulp still fresh, capable of supporting vegetation, and the foliage was in perfect condition.

M. Berthelot has directed his researches to the white glass of ordinary test tubes, which commences to soften at 550 deg. C., and to the Jena glass, which softens only at 700 to 750 deg., and has communicated his conclusions to the Académie des Sciences. Glass kept for a long time at a temperature a little lower than its fusing point becomes opaque, and is devitrified. Softened silica is also at length modified. It is affected more rapidly when heated by the acetylene blowpipe, of which the temperature is sufficiently high for volatilization. The permeability of glass as well as that of softened silica is like that of membranes manifesting osmotic properties. It does not result from the existence of visible holes and fissures. The penetration especially occurs when the silica and glass are softened by heat and thinned by a pressure of interior gases greater than that of the atmospheric pressure. The intervention of this permeability in the current phenomena of chemistry and physics has so far scarcely been suspected. Hereafter, the penetration or dissipation of gases, interior or exterior to vessels regarded as sealed, such as hydrogen, oxygen, nitrogen, helium, and the emanations of radio-active bodies, must be surmised whenever vessels of glass, silica, earthenware, or porcelain, have been raised to a temperature near their point of softening, which occurs in organic analysis, in the reduction of metals by means of hydrogen, in the measurement of high temperatures by means of gas thermometers, and in the determinations of the density of vapors.