SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO. - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*
361 Broadway, New York

FREDERICK CONVERSE BEACH, *Sec'y and Treas.*
361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year, for the United States or Mexico.................... $3.00
One copy, one year, for Canada.. 3.75
One copy, one year, to any foreign country, postage prepaid, £0 18s. 6d. 4.50

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 "

The combined subscription rates and rates to foreign countries, including Canada, 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, AUGUST 17, 1907.

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.

CONCRETE AND CUPIDITY.

The recent fatal collapse of the Bridgman Building in Philadelphia, which took place while it was yet under construction, sounds another warning as to the great perils attaching to careless construction of armored concrete buildings, and the growing necessity for the very strictest supervision of such work. Never has the engineer developed a more useful material of construction than when he devised that ingenious and thoroughly scientific combination known as armored or reinforced concrete. On the other hand, never did he open up to the eyes of the unscrupulous and "shoddy" builder such prospects of unlawfully but quickly acquired gain. Intelligently designed, carefully compounded, and put together with due deliberation and proper time allowances for setting and bonding, armored concrete is one of the cheapest and most reliable forms of building construction the world has ever known. But whenever the design is intrusted to incompetent hands, and the construction done by contractors whose sole concern is to rush the work and secure early payments for the same, armored concrete is one of the most perilous materials that could be imagined. Already the ignorance and cupidity which are rampant have succeeded in putting armored concrete under a heavy cloud of distrust, from which it will take many a long year to recover. If the public is not to lose entire confidence, some speedy reform or drastic preventive legislation must be quickly introduced. The design of reinforced concrete, at least in the case of the more important structures, should be restricted to engineers and architects who are familiar with this branch of the arts, which should be safeguarded by laws drawn up for its special protection.

AMBROSE CHANNEL NOW ONE-HALF COMPLETED.

When the new Cunard liner "Lusitania" reaches Sandy Hook lightship, she will be able to enter New York harbor through a channel 1,000 feet in width, 40 feet deep, and 7 miles in length, cut through the outer bar, and extending from deep-sea soundings to the Narrows. This waterway represents the first half of the great Ambrose channel, which the government is excavating with a view to improving the entrance to New York harbor. If the forecast of the army engineers be correct, in about four years from the present time this great work will be fully completed, and it will be possible for the whole of the maritime traffic to and from the port of New York to steam directly to the Narrows through a channel 2,000 feet in width, which will afford a uniform depth, even at low water, of 40 feet. The full-load draft of the largest ships afloat, the "Lusitania" and "Mauretania," is 37½ feet, and as they will rarely, if ever, draw this much, it is reasonable to suppose that the Ambrose channel will be ample for the needs of navigation, at least for the coming two decades.

Outside of engineering circles the magnitude of this undertaking is but little appreciated. When work was commenced on the contract in 1901, there was a minimum depth of 16 feet of water along the route of the channel. Since that time the suction dredges have removed 26,000,000 cubic yards of sand, gravel, and mud, whose total weight is about 40,000,000 tons. The work, which has cost to date about $2,500,000, will have cost by the time it is completed fully $4,000,000. The two large dredges now engaged on the work cost $400,000 each, and the government proposes to build two more of equal, if not greater, capacity. For the present, the 1,000-foot channel will be restricted to the use of ships drawing 29 feet and over, this arrangement being necessary in order to limit the number of vessels using the new waterway while the dredges are completing the unfinished half of the channel.

SMOKELESS POWDER AND AMMUNITION ROOMS.

The many fatal accidents which have occurred during the past few months on naval vessels, chief among which was the disastrous explosion on the French battleship "Jena," have been traceable, directly or indirectly, to smokeless powder. In many cases the accidents have been due to deterioration of the powder, and in all cases they have resulted from the greater risks which attend either the storage of the powder or its manipulation from the handling room to the breech, or even, as in the case of our own "Georgia" disaster, from the action of the gases after the gun has been fired. While the wonderful increase in the accuracy, range, and striking energy of modern naval ordnance has been due to the high ballistic qualities of smokeless powder, the new propellant has brought with it a whole series of risks, which were little dreamed of in the days of black powder and the muzzle-loading smoothbore. These risks commence as soon as the powder is stowed in the ammunition holds; for not only are modern powders more sensitive to heat than those which they displaced, but the conditions which tend to raise the temperature in the ammunition rooms have multiplied very materially in the modern warship. The sensitiveness to temperature and the tendency to chemical decomposition, both elements of danger, are difficult to remedy; since, as far as our present knowledge goes, they are inherent qualities of the high explosives, or combinations of high explosives, which give to modern smokeless powder its wonderful qualities. On the other hand, the risk from overheating of the ammunition rooms is entirely removable; and the French naval authorities, stimulated by the "Jena" disaster, are giving particular attention to this question. It is realized that arrangements for cooling which are entirely satisfactory for holds intended for carrying perishable provisions, are quite inadequate for ammunition storage. The holds of provision ships are not opened during the whole trip; but ammunition holds have to be constantly opened, in accordance with the requirements of a naval cruise. Consequently, simple cooling by ventilation is not sufficient, and the best modern practice recognizes the necessity for refrigerating the air before it is forced into the hold. The French have installed on several French and Russian ships refrigerating plants, in which a refrigerating liquid is pumped between metallic surfaces, on the outer sides of which air is caused to circulate by means of fans. With these machines it has been found possible to maintain the ammunition holds at a constant temperature.

The problem of the powder is more difficult, since it is not solvable by any mere mechanical system. We have not been so much troubled with chemical decomposition as have some of the European nations, and this for the reason that, many years ago, we adopted, in the navy, an all-nitro-cellulose powder, and, in the army, a powder containing only twenty-five per cent of nitro-glycerine. Because of its great energy in proportion to its bulk, European manufacturers have used nitro-glycerine in large proportions, the earlier English cordite being composed of about sixty per cent of this explosive; but they have naturally experienced much difficulty in producing powders that would remain stable for any reasonable length of time. Of late years they have been coming more to the proportions adopted in this country, the present modified cordite having only about thirty-five per cent of nitroglycerine in its composition. However, even in this country we are experiencing trouble with variation of powder pressure, and this, of course, produces irregularity in the velocity, and therefore in the accuracy of the gun. There is still a demand for a powder that will combine with high ballistic qualities absolute stability in storage and unvarying pressure in the powder chamber.

ROUTE OF CATSKILL AQUEDUCT CHANGED.

As one result of the present extensive surveys, it is probable that an important change will be made in the route of the Catskill aqueduct on that section which extends from the Ashokan reservoir to the easterly shore of the Hudson River. The new route will leave the reservoir at a point near the site of the Olive Bridge dam and further toward the western end of the reservoir. It will extend in a southerly direction, several miles to the westward of the original location, intercepting the Hudson River just above Storm King Mountain. The first location was laid down under the pressure of the necessity of making a speedy choice of some route, in order to comply with legislation which required the Board of Water Supply to file plans with the State Water Supply Commission and secure its approval, before proceeding with the preliminary work. Subsequent surveys have developed the fact that there is no suitable rock for a deep-level tunnel beneath the Hudson River at the proposed crossing. Borings which have been made at various points up and down the river, point to the probability of obtaining unfissured rock in the neighborhood of the Storm King Mountain. Shafts are now being sunk on each side of the river to a depth of about 600 feet below the water surface, and 400 feet below the level at which the aqueduct tunnel reaches the river face of the mountain. When the shafts have reached the desired depth, horizontal test tunnels will be driven across from shaft to shaft—a distance of 2,000 feet—to determine whether the rock is of sufficient solidity and freedom from fissure, to withstand the enormous water pressure of 33 tons to the square foot, which would be exerted against the walls of the tunnel at this depth. If the test tunnel shows the rock to be unsuitable, it is likely that the water will be conveyed in steel pipes or some other form of conduit, laid either upon or at a slight depth below the river bed, at a crossing located a short distance north of the point where the test tunnels are now being driven. A river-bed crossing, however, would be longer than the tunnel and liable to injuries, accidental or malicious, from which the deep tunnel would be protected.

GROWTH OF OUR EXPORTS OF MANUFACTURES.

Over three-quarters of a billion dollars of manufactures passed out of the ports of the United States in the fiscal year which has just ended; and of this enormous total $740,000,000 was sent to foreign countries. A gratifying feature of this trade is the fact that two-thirds of it was shipped in finished form, ready for consumption, and one-third of it in partially manufactured form for further use in manufacturing. Exports of finished manufactures show an increase of about $20,000,000 over last year, and an increase of $267,000,000 over the year 1897; while manufactures for further use in manufacturing show an increase of $34,000,000 over last year, with an increase of $162,000,000 during the past decade. The distribution of this $740,000,000 of manufactures sent abroad last year is instructive. One hundred and eighty-one millions represented the value of iron and steel manufactures, an increase of $20,000,000 over last year, and of this total amount about 85 per cent was shipped in finished form ready for consumption. Exports of manufactures of copper represented $89,000,000, of which $85,000,000 went to Europe. The next largest item was that of manufactures of wood, whose value amounted to $80,000,000, of which $65,000,000 worth was shipped in a partially manufactured form. Next in value was the exports of mineral oils, to the value of $78,000,000, one-half of which went to Europe, one-fifth to Asia, the balance being widely distributed. Of leather and its manufactured products we exported $45,000,000 worth, of which considerably more than one-half went to Europe. Of cotton goods we exported $32,000,000 worth; and agricultural implements represented a value of $27,000,000. Summing up on a basis of distribution, we find that $350,000,000 worth went to Europe; $200,000,000 to North America; $100,000,000 to Asia and Oceania; $75,000,000 to South America; $15,000,000 to Africa; and the remaining balance of $40,000,000 to non-contiguous territories.

A PRIZE FOR THE EXTRACTION OF FLAX.

The New Zealand government has offered a prize of $25,000 for an economical process for the extraction of flax from the native plant, either by chemical or mechanical agency. This plant, which is cultivated in many climates similar to that of New Zealand for its beautiful flower, is entirely distinct from the ordinary plant from which flax is procured. The leaves, which are from one to three inches in width at their broadest part and from two to six feet in length, are of a fibrous nature, and it is from these and not the stalk that the flax is obtained. Bleaching this fiber, however, is a difficult process, owing to the large amount of viscous, resinous, and gummy substances impregnated therewith, and which cannot easily be removed. Consequently, the resultant fiber is only used for the coarser materials, such as sail cloth, where a pure whiteness is not particularly required. The process generally adopted for the extraction of the fiber from the leaves is maceration, but the most efficient and satisfactory, though essentially primitive and slow, is the method practised since time immemorial by the natives. By a deft movement of their thumb nails they remove the thin outer skin from the leaf, and then comb out the fibers with small combs, no macerating process of any description being resorted to. The product thus obtained is of excellent quality, possessing a silky luster and of great strength and durability, and is mostly employed for the manufacture of rope, twine, and mats.

The plant grows very luxuriantly and prolifically, and will thrive in the poorest soils, being found very extensively in a wild state all over the country. When cultivated, three harvests of leaves can be procured every year from each plant, and about twelve tons of leaves can be cut from each acre of cultivation. It is stated, however, that if more scientific methods of cultivation were practised, the yield per plant per acre could easily be doubled. There are already over four hundred mills in operation devoted to the treatment of this flax; the exports from the country averaging over $4,000,000 per annum; and although the product is stronger and more durable than that usually employed, and is in great demand for certain classes of goods, once the degumming problem is satisfactorily surmounted, permitting the flax to be bleached readily and easily, it will constitute a formidable rival to the European and Asiatic fiber, more especially in view of the fact that it is considerably cheaper and stronger than the latter varieties. The government anticipates that by the announcement of the above award greater attention will be attracted to the problem, and a cheap and efficient process for production evolved.

A COLLEGE OF INVENTION.

BY GEORGE FREDERICK STRATTON.

Generally speaking, inventors do not make a business of inventing, but very frequently chance upon ideas which are entirely unconnected with their usual occupations, and which they seize and develop into more or less practical results. What the mental processes are that so frequently turn men from the matters with which they come daily face to face, impelling them to consider entirely foreign problems, is hardly explainable. Fulton, of steamboat fame, was a portrait painter; Morse, the inventor of the telegraph system, was an artist; Whitney, of the cotton gin, was a law student; Arkwright, who invented the spinning jenny, was a barber. Of the group who developed the steam engine, Watt was a mathematical instrument maker, Newcomen a blacksmith, and Smeaton a civil engineer. The list showing similar incongruities could be extended until it embraced a very great majority of all the inventors to whom patents have been granted. But a change has come in the methods by which patentable ideas are taken up and developed. Inventing has grown into a systematized business in which hundreds of men are now actively and steadily engaged; a very large proportion of them under salary from the great industrial corporations.

Highly-trained scientists are rarely inventors. They are rather investigators and discoverers, going deeply into causes and effects; searching for new elements and elemental forces, and determining with mathematical accuracy the scope and extent of such forces. Long before Stephenson the theories of steam—of heat, combustion, and condensation—were ably discussed and philosophically explained, but it remained for the mine laborer to put those theories to practical application in the locomotive.

It must by no means be inferred that the work of eminent scientists and philosophers is lightly thought of. To their great discoveries is due the opportunity of the inventor who follows them, and who, taking advantage of the things they have discovered, devises the means of applying them to practical uses. In short, the great intellects trained to analytical deduction and mathematical exactness concern themselves with theories, principles, research and conditions, leaving the practical results by means of mechanical devices to men less gifted in the qualities they possess, but usually far more greatly endowed with ingenuity and commercial enterprise.

It is the latter class of men for whom industrial managers are eagerly looking, and although inventors are always plentiful, as shown by the records of the Patent Office, they seem to be but seldom available for salaried positions. A firm engaged in the manufacture of textile machinery, and desirous of securing two or three men of mechanical ingenuity, searched the patent records of the preceding year, from which twenty inventors were selected. The list was not confined to improvers of appliances for manufacturing wool and silk, but included those whose patents showed unusual ingenuity in the invention of intricately delicate mechanical devices in any line of industry. Although out of the entire number only one had pushed his invention to a commercial success, from the others the firm succeeded in engaging but one man. The rest were in occupations which they could not be induced to leave. Some were in the professions; the others were small business men, clerks, or mechanics. It was found that although most of them would have been very willing to accept a salary, they were by no means confident of continued ability. Each had invented some remarkably ingenious article, sometimes several, but the idea of engaging in inventing as a permanent occupation—of feeling compelled to focus their ability or genius upon some one definite problem—was so new that it was staggering.

The manager of a great company, which has on its engineering staff nearly one hundred men who might be termed inventors, was recently asked: "Where do you obtain such men?" He replied: "It is not easy to answer. The chief men—the engineers—usually come from the colleges, as do also some of the assistants. But the bulk, upon whom we depend for all the little improvements and changes which are constantly required, come from all over. Some are mechanics; there is a doctor, a tailor, a conductor, and an agent. Most of these were secured when they came with inventions of their own, made when following regular occupations. Usually they turn out well. But we can't always hold them long, and there is trouble to replace them. I wish there was a training school for inventors!"

And why not?

In every other line of endeavor there are organized methods of education and training. For art, literature, law, medicine, and religion we have the great universities and colleges. For technical professions we have technical schools. We have manual training schools and apprentice systems for mechanics. But nowhere is there provision for training, guiding, and developing the very peculiar line of genius known as invention.

To many it may appear that educational opportunity for such men is already afforded by the institutions above noted; but all of them fall far short of the actual requirements for the best and most lucid development of practical inventive ability. Whatever the future holds for the business of inventing, it is to the past we must now look for guidance in determining the men to be helped and the methods of helping them. And that past shows, undeniably, that the most notable and ingenious inventors have not been men to whom abstruse and mathematical studies are familiar.

If we eliminate the universities and technical colleges from consideration as the best training fields for inventive natures, there remain the manual training schools and apprentice systems. And again what do we find? That the inventors of the past and the inventors of to-day have very seldom given their inventive attention to matters actually connected with their regular trade or occupation.

Many peculiarities are found continually in the study of inventors and inventions, and if they show anything, they show indisputably that the inventor is a free lance. The selective system of study or training in colleges, technical schools, and trades is not for the true inventor. Given a young man who has shown undoubted mechanical ingenuity, and keeping the past in mind, his training, commencing after his graduation from grammar school, should consist of the largest scope and opportunity for observing what has been done by others, rather than confinement to routine study. Mechanical drawing he should learn, but only sufficient to enable him to put his own ideas clearly upon paper and to read other drawings. If he is to become a professional inventor, he will not want to waste his time competing with skilled draftsmen. Models and drawings, and lectures thereupon, of every known description of mechanical movements should be provided, and every opportunity given for long and secluded study of the same. The drilling on this branch could not be too comprehensive or thorough. The calculation of the strength of beams and trusses, of the friction of the flow of liquids in pipes, would be wasted time. They are problems for the man of fixed theories and mathematical exactness—not for the imaginative inventor. A comprehensive study of patent laws and their application, and a familiarity with the method of searching for conflicting inventions, would be highly desirable. Lectures should be given upon the commercial view of inventing, so that the young man may gain some insight into the methods of estimating the values of the problems he may be tempted to fix his mind upon. These lectures should also bear upon the formation and practice of stock companies and the adjustment and payment of royalties. The great purpose should be to impress upon the student the wisdom of always putting his efforts upon things which will pay; for in mechanical appliances it is really only those things which pay that are of real benefit. Easy access to manufactories of the greatest possible diversity would be one of the most essential requirements. Such practical demonstrations of machines and tools should be considered a part of the college course, and be made one of the greatest sources of information.

Ample time and opportunity should be afforded for comprehensive study of trade magazines in every line of industry, for it is here more than in any other literature that the requirements of industry are revealed. Specializing of study would seem, in the light of the past, to be wasted time. You may keep a man's attention centered for months or even years on steam-engine construction, and if he is a true inventor he is likely, at any moment, to switch off to a labor-saving device in the shoe-making industry. His education and training should be confined to whatever will enable him to see and appreciate clearly difficulties in any existing apparatus in any line of manufacture, and should give him the confidence and patience to tackle that difficulty and eliminate it. Mechanical deftness is not an absolute necessity, although every opportunity should be afforded to qualify men in the use of tools and the making of their own models.

But above all, the greatest utility of a college of invention would be in its repression of the feverish impulse most inventors have to solve each and every problem presenting itself, merely for the sake of solving it; and in its guidance toward commercial success.

SCIENCE NOTES.

Mr. C. W. Whymper has just brought to notice a curious point with regard to the position of the ear in the woodcock. The snipe, it may be remembered, are remarkable for the fact that the external ear is placed *under*, instead of *behind*, the eye, as in other birds; but in the woodcock it is placed in *front* of the eye, and more so on one side of the head than on the other. This asymmetry, furthermore, extends to the shape of the aperture, which is slightly different on the two sides of the head.

A method of preserving meat has been brought out in France by H. De Lapparent which seems to have met with considerable success. It can be also applied on a small scale for household purposes. The principle consists in exposing the meat to sulphurous acid fumes. By burning a small amount of sulphur in a receptacle containing the meat hung up in place, it can be preserved for several days, even in summer. There is no taste left from the sulphur fumes and there seems to be no danger to health. Such a method can be used also on a large scale for preserving meat for army use, as it is quite simple and easy to apply in practice. From experiments made on a large scale it appears that the meat fumigated with sulphur did not contain more than 22 grammes (340 grains) of sulphurous acid gas per 100 kilogrammes (220 pounds) of meat, which is on the order of ten thousandths. The meat should be fumigated as soon as possible after killing and preferably on parts which have no cut bones. Lean meat is found to keep best. To preserve it for several months, meat can be inclosed in vessels full of carbonic acid gas. It has the appearance of fresh meat and its taste is not changed after cooking. In England, Mr. Lascelles Scott proposed a method which consists in immersing the meat in a solution of bisulphite of lime.

The possibilities of certain grasses being utilized for the purpose of fertilizing, and thereby reclaiming for cultivation, waste stretches such as sand dunes, has been strikingly demonstrated upon King Island, which is situated between the coasts of Tasmania and the Australian mainland. This island has always been an arid waste of sand and other non-arable soil. Some few years ago however a vessel was wrecked off the island, and when broken up under the force of the waves a number of the sailors' mattresses, which were stuffed with the yellow-flowered clover, a kind of grass, were washed ashore. A certain quantity of seed was contained among the stuffing, and in due course these took root, and owing to their prolific growth, in the space of a few years covered the sandy stretches with rich verdure. It is a long-established fact that clover and other leguminous plants have the peculiar capacity of fertilizing a waste soil, owing principally to the action of bacteria, thereby enabling the plants to draw nitrogen directly from the atmosphere. In the case of King Island, owing to the properties of this yellow-flowered clover, what was previously a waste stretch of sand is now one of the richest grazing districts in the Australian continent. The growth of the plant completely changes the character and color of the soil from a dirty white to a rich dark brown or black loamy nature.

THE CURRENT SUPPLEMENT.

From time to time during the past two or three years there have been references to Maguay fiber in the public press, and now small quantities are finding a market in this country. Charles Richards Dodge, in the current SUPPLEMENT, No. 1650, presents a careful *résumé* of his investigation of the varieties of the Maguay fibers, and accompanies his text with many interesting illustrations. A torpedo guided by aerial electrical waves is described. Augustus B. Tripp gives an account of a wireless telegraph apparatus for lecture purposes. There are but few problems in the design of ships, as in most branches of engineering, that can be exactly or completely solved, in the full scientific meaning of the word, and those are of a secondary character. These important problems are considered by Francis Elgar in an excellent paper entitled "Unsolved Problems in the Design and Propulsion of Ships." Lieut. Schackleton's expedition to the Antarctic is described and his equipment illustrated. "The Seed, a Chapter in Evolution," is the title of a paper by Prof. F. W. Oliver which may be considered a trustworthy review of recent knowledge. The paper is concluded from the last SUPPLEMENT. James Asher presents some rough and ready methods of estimating heights and distances. Clocks, Ancient and Modern, are described by W. S. Eichelberger.