SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

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

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) ..... $3.00 a year
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Monthly (Established 1885) ..... 2.50 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, OCTOBER 15, 1904.

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.

ELEVATOR FATALITIES AND THEIR PREVENTION.

Recently, in these columns, we were deploring the number of fatalities that occur in transportation on our railroads; but now it seems that the risk of travel on railroads is insignificant compared with that to which those who use the modern elevator are exposed—at least in New York city. For according to a statement of Coroner Jackson, no less than thirty persons have lost their lives in elevator accidents in this city since the opening of the present year; and, of course, a still larger number of people have received injuries more or less serious. Although we had noticed the frequency with which accounts of elevator disasters appeared in the daily press, we were certainly not prepared for this astounding statement from an official whose duty it is to know the facts. Think of it; thirty deaths in nine months, or a rate of forty per year killed in one city alone, in a form of accident that would be altogether preventable were human life not held so cheap, and were ordinary care exercised in the selection and operation of the plant.

There is absolutely no excuse for ninety-five per cent of the accidents that occur. The problem of providing an elevator that shall be perfectly able to perform its work, year in, year out, without any risk to the passenger, has been most carefully thought out and solved by the best mechanical and engineering talent of the day, with the result that there are on the market to-day elevator systems which, in the hands of competent operators and subjected to constant and competent inspection, provide as safe a form of transportation as any that exists. Unfortunately for the safety of life and limb of the public, accident-proof elevator systems cost money, and the combined parsimony and disregard for human safety of many of the owners of office buildings and warehouses leads to the selection of inferior and cheaper systems, of which there are sadly too many in this city at the present day. Moreover, there is apparently very little care exercised in the selection of operators. The elevators in important and crowded office buildings are often in the hands of mere boys, the test of whose fitness for the job seems to be the small amount of pay for which they will undertake it.

In view of the present condition of affairs, which can only be described as positively alarming, we are glad to learn that the Superintendent of the Department of Public Buildings has drawn up an amendment to the Building Code which seems to cover the case adequately, and will make it possible for the Building Department to enforce any needed alterations in faulty elevators, whether they are used for passengers or freight. The principal items of the amendment are, that the Superintendent of Buildings shall cause an inspection of elevators, whether for passengers or employes, to be made at least every three months, and that he shall prescribe suitable qualifications for persons who are placed in charge of the running of passenger or freight elevators; any repairs found necessary by the Department to be made without delay by the owner or lessee. In case defects are found to exist which endanger life or limb, the use of such elevator, upon notice being given by the Superintendent of Buildings, shall at once cease, and it shall not again be used until the Superintendent has granted a certificate certifying that the elevator has been made safe. Moreover, no person will be permitted to take charge of an elevator, whether for passengers or for freight, unless he shall first register at the office of the Superintendent of Buildings, giving his name and residence, and the location of the building in which he is to be employed, and shall first receive from the Superintendent of Buildings a certificate as to his competency. Now this is a really admirable measure. It covers the case adequately, and if its requirements are honestly carried out without fear or favor, there is no reason why the public should not be as safe in an elevator as they are upon the sidewalk or in their own homes.

BIG GUNS FOR FUTURE WARSHIPS.

Already the naval expert has begun to tabulate the lessons to be gathered from the naval war in the Far East. In some respects they vary widely; but there is one point on which they are all agreed, and that is as to the great value of the larger-caliber guns, say from the 8-inch to the 12-inch, as compared with the more rapid but less powerful guns of 6-inch caliber and less. Before the war we heard a great deal about the wonderful "hail of rapid-fire shell" with which the ship which carried a numerous battery of 5-inch and 6-inch guns was to "smother" her adversary, and "wreck his unprotected sides and upper works." The Japanese tactics, forced upon him by the necessity of defeating the enemy with as little loss as possible to himself, have changed all that. Japan possessed only a limited navy, every ship of which was thrown at once into the field of operations. She had absolutely no reserve to draw upon, and any gap that was made in her fighting line she could not hope to fill up. Hence, in the battles of the war, whether against ships in the open or against land fortifications, she has elected to fight, or rather she had no choice but to fight at long range, trusting to her superior seamanship and gunnery to enable her to place a larger percentage of effective hits upon the enemy than he could hope to do upon her own ships. The events of the war have shown that these tactics were correct; for the enormous losses that her gunners have inflicted upon the enemy have been brought about without the loss of a single ship, or even its serious disablement, at least as far as we know, by Russian gun fire.

To carry on a successful artillery duel at long range, however, is only possible with the high-powered, large-calibered gun. At the ranges of from 5,000 to 8,000 yards, at which the Japanese elected to fight, the 6-inch, 5-inch, and smaller-caliber guns were useless, the velocity of the smaller projectiles falling off so rapidly that they were, at such ranges, altogether ineffectual against the armored portions of a ship. Under such conditions, the engagements resolved themselves into a trial of skill between the marksmen of the 12-inch and 8-inch guns. And how excellent this was on the Japanese side may be judged from the fact that the official report sent in from the flagship "Czarevitch" spoke of her as having received three 12-inch projectiles in the neighborhood of the conning tower within a space of five minutes. Evidently the gun is supreme, and the big gun at that.

The effect of the war is showing itself in the designs for new battleships and cruisers that have lately been divulged. Japan herself has ordered from an English shipyard two battleships that will carry four 12-inch and four 10-inch guns, and a dozen 6-inch. The 10-inch gun forms the main battery of many modern battleships, notably those of the "Pobieda" class, now at Port Arthur, so that practically the new ships will have double the number of armor-piercing guns of the first class that are now carried by modern battleships. The British government are also following the same policy. Their new battleships of the "Lord Nelson" class will carry four 12-inch guns of 45 calibers, but no 6-inch or 7½-inch, their place being taken by ten 9.2-inch guns of 50 calibers. Thus the whole of the main battery consists of armor-piercing guns of long range and great penetrative power, while the intermediate or secondary battery has been abolished, and the vessel carries in its place a numerous battery of small 3-inch and other rapid-firers for protection against torpedo-boat attack. The same policy has been followed in the first-class cruisers of the "Minotaur" class, which will not mount any 6-inch guns, but will be armed with four 50-caliber 9.2-inch guns and ten 50-caliber 7.5-inch rapid-firers.

The 9.2-inch piece, which was recently illustrated in this journal, fires a 380-pound shell with a muzzle velocity of 3,100 feet per second, a muzzle energy of 25,485 foot-tons, and is capable of penetrating 12 inches of Krupp steel at a range of 3,000 yards. The 7.5-inch gun, which forms the secondary battery of the cruisers, has a muzzle velocity of 3,000 feet per second, and fires a 200-pound shell, with a muzzle energy of 12,540 foot-tons, and is capable of penetrating 8 inches of Krupp steel at a range of 3,000 yards. It is an interesting conjecture as to just where this progression toward the exclusive use of the larger-caliber guns will go; but it begins to look altogether possible, that before long we shall see the dream of Admiral Cuniberti of the Italian navy realized, when he drew up his plans for a 17,000-ton battleship, carrying an armament of twelve 12-inch guns and a dozen 12-pounders.

EXPERIMENTS ON THE MOSQUITO.

BY T. H. EVANS, M.D.

If the following experiments are interesting and curious they may also be valuable, for any matter concerning the habits of *Stegomyia fasciata* is of use in view of their relation to the transmission of infectious disease, as malaria, yellow fever, etc.

Experiment I. Securing the mosquito so that it cannot escape, and allowing the wings and proboscis free movement, a drop of liquid on the end of a blunt probe is approached to the proboscis. When the distance of the proboscis from the drop of liquid is reduced to about two millimeters, the proboscis darts into it. Various liquids seem to bring about different distances of attraction.

Experiment II. If a drop of lysol, a phenol derivative, has been used, the proboscis darts into it at the distance of two millimeters. In the space of two or three seconds the wings relax and droop, but do not flutter unless the experiment has been performed while they were in that state of excitement.

Experiment III. A solution of ammonia produces the same results, but in shorter time and over a wider interval of attraction.

Experiment IV. Repeated tests on the same animal, using poisonous solutions, give identical results while life lasts. From the fact that the proboscis continues to fly toward even poisonous solutions, and after their effects are apparent in weakening of vitality, I take it that—

(a) The movement of the proboscis is not voluntary, or not under the control of a reasoning intelligence.

(b) There is some inward suction, more or less constant, in the passageway of the proboscis.

(c) Lysol and other solutions may produce poisonous effects when introduced by means of this passageway to the mosquito's economy.

ARSENIC NEEDED FOR THE BODY AND FOUND IN DIFFERENT FOODS.

Not long ago M. Armand Gautier brought out the fact that arsenic is contained in minute quantities in nearly all the organs of the body. In some of the organs the proportion is relatively large, and leads us to suppose that this element is necessary for the proper working of these organs, and indeed plays an important rôle in the entire system. In a paper which he recently presented to the Académie des Sciences he brings out some further researches upon this point. These relate especially to the different kinds of food from which the system takes its supply of arsenic. This element is found in a large proportion in the exterior parts of the body, and a certain amount is constantly being lost through the falling or cutting of the hair and nails, and also by the natural evacuations. It became therefore of interest to find out from what sources the system receives the amount of arsenic which is needed to keep up the normal amount, and what is the proportion given by the various kinds of food, both animal and vegetable. Accordingly he made a series of analyses of different foods and showed the quantity of arsenic in each. The method he uses is to break down the organic tissue by a mixture of one part sulphuric and ten parts nitric acid. This is carried out at a low temperature. After re-treating with nitric acid the whole is finally carbonized. The arsenic is set free by a Marsh apparatus, at least in most cases. In the case of salt and water it is found by direct precipitation. Great care was of course taken to use perfectly pure reagents. The following extracts are taken from the table which M. Gautier has drawn up as showing the percentage of arsenic in different foods, water, and salt absorbed by the body. The figure gives the weight of arsenic in 0.001 milligramme per 100 grammes (0.22 pound) of solids in the fresh state or in 1 liter of liquid: Beef (lean), 0.8; milk, 1.0; eggs, yolk, 0.5; white, 0.0; mackerel, 3.9; lobster (muscular part), 2.2; eggs, 35.7; shell, 104; water extract, 10.7; shrimp, 0.16; shell of same, 7.6; wheat, 0.7; potato, 1.12; wine, 0.89; beer, 0.01; salt, refined, 0.7; gray salt, 45; rock salt, 14; Seine water, 0.5; sea water from surface, 1.1; from 30 feet depth, 2.5. The unusually large proportion contained in lobster shell and unrefined salt will be noted. Eggs have also a very high value.

From these results we may draw certain conclusions. The proportion of arsenic is extremely small in the muscular flesh of mammals as compared with that which the arsenic-bearing organs contain. Among the different foods, some of the fish and crustaceans, and especially their more highly phosphated products, are found to contain the largest proportion of arsenic. Rock salt is also one of the highest in the list. Wheat bread contains very little, and the proportion is not greater for Graham bread, showing that this element is not furnished by the bran. Green leaves, cabbage, and green beans do not show a trace of it, even in a large quantity of matter. This seems to show that arsenic is not essential for cell-life, at least in the proportion of 0.001 milligramme per kilogramme. On the contrary, the system derives a considerable quantity from water, wine, and common salt. M. Gautier utilizes his results to make an interesting calculation as to just how much arsenic an inhabitant of Paris absorbs per day on the average, taking as a base the statistics for the last decade. The result is as follows: The first figure gives the number of grammes (15.43 grains) of food per day, and the second the quantity of arsenic (in 0.001 milligramme): Bread and pastry, 420 grammes per day (arsenic, 2.9); meat, 180 (1.8); fish, 35 (4.3); eggs, 24 (0.05); vegetables, fresh, 250 (0.5); vegetables, dry, 40 (?); potatoes, 100 (1.12); milk, 213 (0.10); wine, 518 (2.9); beer, 30 (0.0); salt, 10 (2.3);

water, 1 liter (5.0). The total quantity of arsenic taken into the system per day thus figures very close to 0.021 milligramme, or about 0.0003 grain.

AUTOMOBILE STEEL SPECIALTIES.

BY GEORGE E. WALSH.

The manufacture of automobiles has reached such a stage of development that it proves a most important factor in the iron and steel trade. The millions of dollars invested in automobile plants indicate something of the growth of this special line of business. Already the tendency toward the standardization of the different parts of the automobile has progressed rapidly, and it may not be long before shops will be established for the mere assembling of the machines without any attempt to manufacture. Under existing conditions of patent rights and special manufacturing methods, it is possible to do this to-day without infringing upon the rights of others.

Automobile steel has called for special lines of manufacture and experiment that have proved of advantage to mills anxious to capture this trade. The amount of steel that goes into the ordinary automobile is variously estimated from ¼ to 1 ton, according to the size and capacity of the machine either for passenger or freight traffic. If the average is placed at 1,000 pounds, a manufacturing output of 5,000 machines a year would represent a total tonnage of 5,000,000 pounds of steel required for this particular line of industry. But this estimate is comparatively low, and within a year or two the plants will be turning out far more than this number. The orders at the last automobile exhibition in New York for new machines amounted to considerably more than a million dollars. With the average cost of a machine placed at a thousand dollars, this would represent over a thousand machines sold or ordered in one brief fortnight.

The iron and steel used in automobiles represents all degrees of hardness and strength. For the most part only the finest steel can enter into the manufacture of the driving part of the vehicle, and in the case of the high-power automobiles unusual strength of parts is required. In the specialization of parts there has grown up a line of steel manufacturing that is of peculiar interest.

The gears, chains, springs, and machine parts require steel so strong that it will stand the greatest resisting power. Extensive experiments have been carried on in some of the automobile plants with steel to test its qualities for the driving parts of the high-power automobiles. In one such series of tests over fifty tons of steel billets were destroyed to secure the most efficient results. As in the manufacture of high-power tool steel, there has been a gradual series of experiments that have virtually led up to the production of an article satisfactory to the trade. Most of the large automobile manufacturers have their own ideas of the kind and quality of steel they need, and the chemical tests and analyses show that they differ in the composition to only a slight degree. As the strength of the automobile must in the last analysis depend upon the quality of the steel used for the most important parts, it is quite evident that the manufacturers are justified in studying this problem exhaustively. In the former cheap grades of machines, the breakdowns were due to some inferior steel parts that would give way in critical moments under the stress of special strains imposed upon them.

The modern American automobile is nearly, if not quite, as strong, powerful, and durable as the best French machines, and it is due as much to the special manufacture of important steel parts as to the gradual perfection of boiler, engines, and electrical equipments. A good many of the manufacturers require air-hardened steel for parts that must be subjected to considerable strain and friction in the operation of the machines. The heating of the steel to a high temperature, and cooling suddenly in a blast of air, can give to the steel the desirable hardening qualities; but unless the compressed air-blast is sufficient to reduce the temperature of the steel uniformly and quickly there is always the danger of cracking and weakening of the parts.

As in the manufacture of steel for cutting tools and other high-grade purposes, there is a good deal of difference of opinion in the automobile trade as to the methods of obtaining the best steel for the machines. The application of water for reducing the temperature of the steel is employed differently in the various plants. There seems to be no absolute consensus of opinion in the trade regarding the exact treatment of the steel. A manufacturer who has had success with steel treated in one way cannot easily be induced to adopt any other method. He is slow to adopt new products of the steel trade.

Nevertheless, steel mills are not indifferent to the demands of the new trade. They have taken the matter up for serious consideration, and some of them are constantly carrying on tests for the benefit of the automobile trade, exhibiting to their customers the data thus obtained for their benefit. Thus in manufacturing the chains, sprocket wheels, and gearing of the high-power automobiles, specially refined and annealed steel has been made, which will practically withstand any amount of strain that can be imposed upon it by even a forty-horse-power motor. This steel is not only chemically perfect, but it can be made in the most uniform manner. This latter point is one of great importance to the automobile manufacturers. A standard machine must be guaranteed in all particulars, and each successive machine must be up to the same standard. Any lack of uniformity in the steel parts would manifestly handicap the manufacturers in guaranteeing the durability of the machines.

The wear and tear on automobiles must necessarily be greater than on cars which run on smooth rails or tracks, and consequently the item of repairs has always been large. The life of an automobile has been short owing to the lack of uniformity of steel parts, but manufacturers to-day are willing to guarantee the life of the average machine to be nearly twenty per cent longer than that of the machine built five years ago. This is largely due to the superiority of the parts used, and their more perfect operation when in use. The quality of the steel employed has steadily enhanced the usefulness of the automobile, and also improved its power and durability.

The cost of manufacture is always an item of prime importance, and the temptation to use inferior steel parts to lessen the cost of manufacture is strong, but it must be said in all fairness that few of the responsible manufacturers of machines in this country are willing to sacrifice the reputation of their machines through any such short-sighted policy of false economy. The tendency is to use the best steel more and more, and to have every piece severely tested chemically and mechanically. The chemical test does not count for much in many plants, while special stress is placed upon the mechanical test. In other plants special emphasis is placed upon the chemical test, and all steel is immediately rejected that will not come up to the required chemical test. The later mechanical test is then applied to make sure of the accuracy of the first. The cost of maintaining a special laboratory for chemical and mechanical tests of all steel parts is quite considerable, and some of the plants are anxious to abolish it as a part of their equipment. But in their opinion this can only be done when manufacturers of steel will furnish them with a guaranteed uniform steel of certain qualities. Several of the steel plants are doing this to-day, furnishing elaborate data of chemical and mechanical tests with each piece of steel manufactured. These tests are open to the inspection of all, and the automobile manufacturers can any day assure themselves by personal inspection of the accuracy of the tests.

MUNICIPAL BAKERY EXPERIMENTS IN SICILY.

The British consul at Sicily, in his latest reports, supplies some interesting details concerning the experiments of the Palermo municipality with baking and supplying breadstuffs for the inhabitants. During the past few years, the flour trade of Palermo had been effectively cornered by one private establishment, and became practically a monopoly. It is estimated that the population of the city, which aggregates about 325,000 persons, consumes 260,000 pounds of bread and 110,000 pounds of macaroni daily. As the constituents of these staple foods were in the hands of one firm, the price of common bread was inflated to five cents per pound, thereby causing distress among the poorer classes of the city. Thereupon, in order to alleviate this suffering, the civic authorities decided to establish municipal bakeries.

In March, 1903, the system was inaugurated by the baking of some 20,000 pounds of bread daily. The success of the experiment necessitated the utilization of the military emergency ovens, capable of turning out 11,000 pounds of bread per diem. In May the municipality acquired a private flour mill on a two years' contract. This mill was of Italian construction. It employs 55 hands permanently, and 30 day laborers, and can turn out in 24 hours, working day and night, about 50 tons of flour. Attached to the mill is an old-fashioned bakery capable of producing 20,000 pounds of bread daily, and a modern bakery, which kneads the flour mechanically and produces 8,800 pounds of bread per diem. During the initial stages of this municipal venture, municipal officials were detailed to the work in almost all its branches, and the municipal police retailed the bread in huts placed in the principal streets. The sum of $30,000 was set aside as capital for working the mill and bakery. The municipality actually produces some 44,000 pounds of bread daily—about a sixth of the daily consumption of the city of Palermo. It serves the purpose of maintaining the standard rates which the municipality considered equitable, and allowing a fair profit to the trade. The net result has been a reduction of the prices of the different qualities of bread by about one cent per pound.

The municipality retails its flour and by-products to the public. There are twenty-four shanties where the bread is sold by municipal guards, who receive, in addition to their ordinary pay, a premium of two cents per five dollars of cash taken. When the shanties were first put up, a good deal of hostility was shown them. Private retail dealers are encouraged to take up the distribution of the bread. They pay all their expenses out of a profit of 15 cents per 200 pounds weight of bread, which is delivered to them free. At the present moment there are some thirty such retail dealers. The municipality is planning the erection of a flour mill capable of dealing with 300 tons of grain daily, and of a bakery which shall produce 26,500 pounds of bread, besides pastes, daily.

AUTOMOBILE NOTES.

In a crowded garage, there is often considerable difficulty in moving the vehicles around in getting them in and out of their places, and in order that this may be done with the least possible expense of floor space, a western manufacturer of accessories has made a roller device more like a roller skate than anything else, which is designed to be slipped under the wheels of the automobile, whereupon it may move around in its own length. A pair of these will answer all purposes and it is not necessary to have one of the devices under each wheel. The wheels on these are pivoted in the same manner as casters.

Among the recently introduced automobile accessories is a leather tire which comes from England and which is said to be much more serviceable and less expensive than the tires of rubber. The tire consists of an inner tube and shoe, with an additional shoe of leather. Over the running surface of the leather shoe is an auxiliary strip of leather fastened with a number of heavy rivets. The double ply of leather makes a very substantial tire, and the metal of the rivets is said to take a hold on the surface of the road, no matter what its character, that makes anything like an anti-skidding device quite unnecessary.

The Automobile Club of France announces that the next annual show will be held in the Grand Palais from the 9th to the 25th of December. In order to make this year's show especially brilliant the committee is organizing an annex show in the large Horticultural Building near by. Here will be found a series of veritable factories, which will give the public an idea of the successive phases of construction of an automobile car. Already numerous propositions have come in to the commission and no doubt many of the large firms will be represented. This will form an interesting feature of the show, and a most instructive one.

By the arrival in New York on October 7 of the 24-horse-power Columbia touring car, the Chicago-New York road record for the intervening distance of 1,127 miles was reduced to 58 hours and 45 minutes. The car was driven by H. H. Holcomb, Lawrence Duffy, and E. C. Bald, who alternated at the wheel. The best previous record, which was made a short time ago by Messrs. Ellis and Schmidt, of Chicago, in an Apperson car, was 72 hours, 36 minutes, so that the new record very materially reduces this. The last part of the journey was through the Catskill Mountains and was made through heavy showers; but not a mishap occurred then or throughout any of the trip. The test has shown well the endurance of the stock Columbia machine.

It would hardly seem likely that there would be any demand for a bucket capable of being carried in the pocket, but such a device has been recently placed on the market. The thing was primarily designed for the use of automobilists who require to take on a supply of water at regular intervals but it is also said to be a convenience to campers and tourists. The device is made of waterproofed material fastened to a jointed frame, and when it is desired to pack the thing in a small space, it can be folded up to a size about the same as a pocket hat. If it were necessary to carry the bucket in the pocket it could be done without trouble. Since putting the bucket on the market the manufacturers have made and are selling a small bath-tub on precisely the same lines, which is said to be a great convenience in the nursery.

A new type of tire especially adapted for automobiles has been designed by a London inventor. Instead of a single inner air tube there are two, placed side by side on a steel rim. These are inclosed and protected by an outer head made of hard *papier maché* in sections of twelve or more. Each of these tread shields, as they are called, is attached to the rim of the wheel, by means of a bolt which has a free up and down movement, but has no lateral play. When all these shields are fixed in position, they constitute a kind of armor around the two air tubes. By this arrangement it is claimed punctures are rendered impossible, unless the *papier maché* is pierced, which, in view of its hard texture, is considered impossible. The heads, however, present a resilient surface to the road. Precautions against side slip are provided by means of links which are placed between each tread shield.