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 "

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, FEBRUARY 16, 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.

GOVERNMENT REGULATION OF NIAGARA POWER.

The decision recently promulgated, under the Burton act, by Secretary of War Taft regarding government regulation of the utilization of the hydraulic power of Niagara Falls, has put a very effective stop to the alarming encroachments which the various power companies were making on the volume of the upper Niagara River, upon which the world-famous Falls depend for their scenic beauty. The decision allows the various existing companies on the American side to draw from the upper river volumes of water which are practically the same as those which are now utilized, and are permitted, as a maximum amount, by the provisions of the Burton act. The Niagara Falls Power Company may take 8,600 cubic feet per second, and the Niagara Falls Hydraulic Power and Manufacturing Company is restricted to 6,500 cubic feet per second. Power generated on the Canadian side may be imported in the following amounts: The International Railway Company, 1,500 horse-power; Ontario Power Company, 60,000 horse-power; Canadian-Niagara Falls Power Company, 52,500 horse-power; and the Electrical Development Company, 46,000 horse-power; making a total amount, which may be imported into the United States, of 160,000 horse-power. The Secretary of War may revoke these permits at his pleasure, and in any case, in the absence of any further legislation by Congress, they expire on June 29, 1909. Under these permits, there may be drawn from the upper river a total amount of 15,100 cubic feet per second on the American side, all of which is now being taken, and on the Canadian side they cover about 12,000 feet per second, of which last amount it is likely that about 5,000 cubic feet per second will be drawn during the three years covered by the permits. The volume of water passing over the Falls is estimated to be about 220,000 cubic feet per second; and as the total amount that will be drawn off during the coming three years is only about 20,000 cubic feet per second, it will be seen that the action of the United States government has effectively checked the desecration of the Falls, at least as far as American control of them is concerned, before it had proceeded to a point where the beauty and majesty of the Falls were seriously impaired.

Secretary Taft has done his work thoroughly; for not only is the further withdrawal of water to be prevented; but steps are to be taken to mitigate, if not remove, the unsightly conditions on the American side of the canyon below the Falls, the effect of which upon the sightseer is described as being that produced by looking at the backyard of a house negligently kept. A committee has been appointed to consider the question of restoring the American side of the canyon at this point, so as to put it once more in harmony with the Falls and other surroundings, and conceal, as far as possible, the raw commercial aspect that now offends the eye.

STUPENDOUS WATER SUPPLY SCHEME.

Three of the leading hydraulic engineers of the country have recently reported favorably upon what is probably the most daring municipal water supply scheme that has ever been projected. We refer to the proposal, which we understand has every prospect of being successfully prosecuted, to supply the city of Los Angeles and the surrounding district with an abundant supply of water drawn from the distant Sierra Mountains. The scheme involves, first, the construction of a conduit 226 miles in length, capable of supplying the city with a quarter of a billion gallons of water daily; second, the construction of large storage reservoirs, a single one of which will have the enormous capacity of 85 billion gallons of water; and lastly, the development of a total of 100,000 horsepower, available for six days of the week and nine hours of each day, the greater part of which can be developed within a distance of 45 miles of the city. The total cost of this very ambitious undertaking will be about $25,000,000. The guarantee for planning this work on a scale of such magnitude is to be found in the certain and very large income to be derived from the sale of water for irrigation purposes and for power, in and around a city which doubled its population in the ten years preceding the last census, and is recognized to-day as being, next to San Francisco, the most important commercial center in the flourishing State of California.

A SIMPLE-CYLINDER SUPERHEAT LOCOMOTIVE TEST.

An important question now being investigated by locomotive builders is the comparative efficiency of compound locomotives using high steam pressure and simple locomotives using low steam pressure with superheat. There has now been in operation on the Atchison, Topeka, and Santa Fé Railroad for over a year a simple-cylinder locomotive, which is identical with a class of compound locomotives operating on that road, in every particular except its cylinders, its boiler pressure, and the fact that it is provided with a superheater. The compound engines have tandem, compound cylinders, there being a 19-inch high and a 32-inch low on each side of the boiler, with a common stroke of 32 inches. The type was changed, in the experimental locomotive, by leaving out the 19-inch high-pressure cylinders (thus transforming the locomotive into a simple engine with two 32-inch diameter by 32-inch stroke cylinders), providing the boiler with a superheater, and lowering the pressure from 225 pounds of steam to 140 pounds, the superheater being built for the provision of 70 degrees of superheat. The locomotive started service with 130 pounds pressure, and this was successively raised to 135, 140, 145, finally to 150 pounds. The superheat ranged between 30 and 40 degrees. In spite of the failure to realize the expected 70 degrees of superheat, the locomotive has shown an efficiency within 5 per cent of that of the compound engines engaged in the same service. The record of this locomotive has been excellent, as is shown by the fact that it requires less repairs, and has been for a greater total time in service, than the compounds. Moreover, it is popular with the engineers, and by them preferred to the compound, not only because it requires less repairs, but on account of its adaptability to the water used on the division on which it has been working, which has the bad quality of excessive foaming. The absence of foaming is due to the drying-out effect of the superheater on the water carried over with the steam. The fuller data which will be available when the official report is made, will be awaited with no little interest. In this connection it should be noted that the value of superheated steam in locomotive service is to be investigated by Prof. Goss, of Purdue University, under a special grant of $3,000 a year for four years from the Carnegie Institution.

ONE YEAR'S WEAR OF A STEAM TURBINE.

The economy of the steam turbine in certain classes of service is fully established. Its mechanical durability, however, is not so well known, and indeed the serious wrecking of the blades in some of the earlier machines had raised a reasonable doubt upon this point. Valuable testimony to the wearing qualities of the Parsons turbine, however, was recently given in a report, by the vice-president and manager of the operating department of the Baltimore Power Company, on the condition and performance of the turbines at the Gold Street car station, where the equipment consists of three 2,800-horse-power steam turbine units, the first of which was placed in service in July, 1905, the second in August, 1905, and the third in April, 1906. Recently the second unit was opened, after eleven months of more or less constant service, and a thorough examination was made. The machine was found to be, as regards its general condition, as good as when first installed; and although saturated steam had been used, no blades were missing in either cylinder or spindle; nor was there any evidence of erosion, both edges of the blades and the steam surfaces of the same being intact. Furthermore, careful examination was made of the ends of the blades and of the inner surfaces of the cylinder which faced them, and also of the surface of the spindle barrels facing the ends of the blades which project inwardly from the cylinder. In neither case was there the slightest evidence of contact or rubbing between the two. Mechanically, then, this turbine must be admitted to have fulfilled every expectation.

As regards operation, the report states that the service rendered has been very satisfactory. The plant gives a twenty-four-hour service with a load varying from 12 to 15 per cent during week days, down to 5 to 8 per cent on Sundays. The turbines have shown that they are well suited to a high vacuum, no extraordinary trouble having been experienced in providing a vacuum within one inch of the barometer, particularly during cold weather. Notwithstanding the low load factor of 12 to 15 per cent, the station for one month averaged 3.36 pounds of coal per kilowatt hour generated, including all coal for banking and changing boilers, the coal being largely of bituminous mine cuttings. The corresponding water consumption of the station during the same month averaged 23.9 pounds per kilowatt hour. All of the condensed steam from the turbines is used for boiler feed water. During the same month the actual evaporation from a feed temperature of 180 deg. Fah. averaged 7.11 pounds of saturated steam per pound of coal. In concluding the report, the vice-president states that from an operating standpoint, steam-turbine motive-power equipment has proved eminently successful. It has been found to be entirely suitable for central station service, permanent in construction and adjustment, and economical of steam especially at low loads. Finally, the turbine plant is simple to operate, requiring less attention both skilled and unskilled than a reciprocating engine plant of corresponding size.

REINFORCED CONCRETE CONSTRUCTION ON THE PACIFIC COAST.

Already it is quite apparent that reinforced concrete is to enter largely in the reconstruction of San Francisco. There is scarcely a block in the downtown burned district that will not soon boast of at least one reinforced concrete building, for they are to be seen on every hand in various stages of construction. A five-story building on the corner of Geary and Market Streets, is the first structure of this kind to be occupied, while several others of from three to seven stories are in course of erection.

The most notable reinforced concrete building which has yet been announced for San Francisco is to be erected on the corner of Fourth and Market Streets, the site of the old Flood Building. It will be nine stories high and will cost $1,000,000. Its exterior, for the first two stories, will be veneered with ceramic tile in rich browns. Above the second story the entire front will be faced with cream-colored glazed terra cotta in rich detail. The corridors and lobbies will be finished in imported marbles, and six electric high-speed elevators will be installed. One remarkable feature of this concrete structure is the fact that nine stories are made possible within the limit of height to which concrete buildings are restricted by the city ordinance—one hundred and two feet. The first story will have a height of twenty feet; the second, twelve feet; and the other stories, ten feet each. By an ingenious arrangement of the structure, the fact that the roof is of concrete makes it possible to dispense entirely with an attic story.

The concrete firms declare that no other construction will stand fire and earthquake as well as reinforced concrete; and according to investigations made by the California Promotion Committee, it would seem that the facts bear out this assertion. It is well known, for example, that the museum at Stanford University was built seventeen years ago of reinforced concrete, being the first building of its kind in California. As compared with our modern methods, it was a very crude example of reinforced concrete construction. Nevertheless, it stood the earthquake admirably. One statue was thrown from the top, and all the marble statuary in the interior was toppled to the floor and broken. The pictures on the walls were swung with their faces toward the wall. However, the building sustained no damage, not even being cracked in the slightest extent. The girls' dormitory was also of concrete construction except in the roof. The roof was badly damaged, but the remainder of the building was only slightly injured.

In San Francisco, the Bekins warehouse was constructed with brick walls, and reinforced concrete for all other parts, such as floors, girders, and interior columns. This building sustained practically no damage either from fire or earthquake. At the time of the quake the building was under construction, and but two stories had been completed. The first story had already been filled with inflammable merchandise, which was entirely consumed. The building was not damaged in the least.

There were many other buildings in San Francisco having reinforced concrete floors. The National Board of Fire Underwriters' report of the San Francisco disaster shows that less than five per cent of these reinforced concrete floors were damaged.

In the Baltimore fire there were two buildings of reinforced concrete in the hottest part of the conflagration. One of these was five stories high with brick walls, and all the interior construction of reinforced concrete. The brick walls were destroyed by the intense heat, leaving the entire interior construction standing, with the full five stories practically undamaged, and requiring only the outer walls to be replaced to fit the building for use. The other building was a bank. The first two stories were of reinforced concrete construction, with three stories above of brick and timber. The upper stories were entirely destroyed, heaping great piles of debris into the top of the two concrete floors. The two concrete stories suffered no damage, not even the woodwork being burned.

In Los Angeles, reinforced concrete has been more extensively used than in any other city in the United States up to the present time. The immense Audi-

torium Building, which has just been opened with a season of grand opera, is unique in many ways. It is noted for three features which have never before been undertaken in reinforced concrete construction—a concrete roof construction, a great balcony overhang, and cement girders carrying extraordinary loads. The balcony was loaded with a test load of 680 pounds to the square foot and, as the overhang is 31 feet, it was expected that the deflection would be considerable. As a matter of fact, it was only one-twelfth of an inch on the front. Great trusses were used in this building, 112 feet in height, with a depth in the center of 11 feet. When the false work was removed, they showed so little deflection that it was hardly measurable. With an applied load of 100 pounds to the foot, they showed a deflection of only an eighth of an inch. The girders make a span of 42 feet and have a depth of 63 inches. They carry a concentrated load of 100 pounds to the foot, the center load being a concrete column running through five stories and an attic. While greater spans for bridge work have been executed in reinforced concrete, no roof construction has ever been attempted before that approaches this in magnitude. It suggests the wide range of application of reinforced concrete construction, which, although it is extending so rapidly, is still in its infancy.

THE ODORS OF METALS.

The statement found in most treatises, that metals are inodorous, is contradicted by the most elementary daily observation.

According to experiments recently made by Herr C. Gruhn, of Berlin, the mechanism of smell, at least in the case of metals, is, however, entirely different. The following account of these researches will even show the very general interest attaching to this problem. He found that a piece of old metal (copper, aluminium, tin, zinc, iron, lead, etc.) at ordinary temperatures possesses a slight smell which many persons are unable to detect. The same piece of metal having been heated above a lamp to a moderate temperature is found to give out a very strong smell, which is readily distinguished by any one. From experiments so far made, it would seem that the condition (either pure or oxidized) of the surface of the metal does not exert any influence on the quality or intensity of this smell.

If a piece of metal be heated during some length of time (about an hour), its temperature being kept constant, it at first gives out a very strong smell, which, however, gradually decreases in intensity, until it is just equivalent to the smell given out in the cold state. If, however, the heating be discontinued and the metal cooled, it no longer shows the least trace of smell. Another heating effected immediately afterward will produce only a feeble smell; the metal thus appears to have become well-nigh exhausted.

If the same increase in temperature be imparted to another sample of the same metal, the stronger effects of the fresh metal become specially striking. These phenomena always occur in exactly the same manner.

Gruhn infers that the matter vaporized during the heating is not identical with the metal itself. In fact, it would be difficult to understand why the vaporization of the metal should eventually cease in the case of a prolonged heating. It certainly could be objected that a prolonged heating would result in the production of an oxide layer at the surface of the metal, putting an end to vaporization. The experiments described, however, show that a layer of oxide in no way interferes with the emission of smell from a heated metal.

The phenomena described in the following experiment afford a very striking evidence of Herr Gruhn's hypothesis. A piece of metal having been deprived of its smell and kept in the cold state during two to three hours, is heated anew. It is then found to have been restored to its previous power, smelling as strongly as a fresh piece of metal. This experiment can be repeated over again with the same success any number of times.

It should be remembered that the temperatures involved are by no means excessive, a temperature of 122 deg. F. being quite sufficient. In fact, a fresh piece of metal will give out a rather strong smell even on being heated through 40 to 50 deg. F.

From these experiments Herr Gruhn draws the conclusion that the metal continually gives out an emanation of gaseous matter, composed, not of atoms of the metal, but rather of a product of transformation from these atoms. The metal possesses the power of storing this odorous matter in the same way as carbonic acid is stored in water. To each given temperature corresponds a maximum amount of odorous matter which the metal is capable of retaining. The metal thus becomes saturated. A voluntary prolonged cooling should accordingly result in a more copious accumulation of odorous matter in the metal. This is really borne out by Herr Gruhn's experiments.

The experimenter has finally succeeded in separating and isolating in a vessel the odor given out from a metal, which thus behaves in exactly the same way as the emanations of radioactive bodies.

The odoriferous phenomena described are probably not characteristic of metals only, but are shared by all bodies, and being perfectly analogous to radioactive phenomena, point to the existence of some universal law.

Radioactive salts are known likewise to give out spontaneously and continually an emanation of gaseous matter that in a similar way is driven out by heat, only to be incessantly reformed during a prolonged rest in the cold state. While the radioactive emanation is gaged by the ionization of air, the odorous emanation of metals is gaged by the nose. The various radioactive emanations have been found on the other hand to undergo multiple conversions, eventually passing into a stable condition, as illustrated by the chain of conversions leading from radium to helium. In view of the universal analogies exhibited by the laws of nature, the odors of metals are likely to pass through a similar series of transformations as radioactive emanations. There is no reason for supposing that the electroscope, which has rendered such excellent service in detecting radioactive substances, will suffice for perceiving all emanations that may be discovered in the future. It will rather be the task of science to look for ever-new reagents enlarging our perceptive faculties. Such a means of extending the scope of our senses is for instance the torsional balance, by means of which Herr Gruhn has been able to ascertain the existence of peculiar emanations in the atmosphere.

AERIAL NAVIGATION PRIZES.

Of a somewhat sensational nature is the announcement of a $50,000 aeronautic prize offered at Paris. The prize in question is to be awarded for an aerial flight from Paris to London, and the largest part of the sum is subscribed by one of the leading daily journals, Le Matin, which offers $20,000. The remainder is subscribed in equal portions of $10,000 by Marquis de Dion, M. Clement, and M. Charley, all three of whom figure prominently in the automobile world. According to the rules which have already appeared regarding the contest, the event will take place in 1908 and there are two essential points, first, that all possible kinds of aerial craft are admitted to the contest, and second, that the motors employed on all the flying machines must be of French construction. The aeronauts themselves may, however, be of any nationality. In any event, not regarding the state of the atmosphere, the start will take place from Paris on the 14th of July (the national holiday), 1908. Should the $50,000 prize not be won at that time, other starts will be fixed for the second Sundays of August, September, and October so as to have the event closed in the year 1908 if possible. The distance is 212 miles.

The amount of the prize will be awarded directly by the donors to the proprietor of the winning flyer who arrives the first within a maximum period of twenty-four hours exclusively through the air and using only the power contained within such apparatus. For the start a point will be fixed in or near the city at a later date. The finish will be noted by the dropping of a marked bag from the flyer, which is to fall within a circle of 25 meters (82 feet) radius about the finish point. Ten o'clock in the morning is the hour fixed for the start. It is to be noted that stops *en route* are to be allowed for taking on fuel and other supplies. All the motors are to be of French make. Closing of the engagement lists will take place thirty days before each start. No competitors will be allowed to enter who have not made a good performance beforehand with their aerial flyers, according to the testimony of reliable persons. Questions which are not settled by the regulations may be brought before the committee for decision, and this will be final. The announcement of such a large prize has awakened a great interest, as may be naturally expected, in aeronautic circles in Paris and elsewhere, and it will go far toward stimulating the activity of aeronauts, especially in France.

When the Daily Mail offered the sum of £10,000 ($50,000) on certain conditions for an aeroplane flight from London to Manchester, The Car, a London automobile paper, offered through the medium of the Daily Mail £5 ($25) per mile with the low minimum of twenty-five miles to be covered, and a challenge trophy value of 500 guineas ($2,500) for the longest flight taken in Great Britain in any one year.

The Brooklands Automobile Racing Club, of England, offers a money prize of £2,500 ($12,500) for any aeronaut who wins a race in the air by covering the prescribed course once. The date of the race will probably be in June or July next, so as to give plenty of time for construction and experiments. The prize will be given to the owner of any aeroplane, heavier than air, which completes the circuit of the Brooklands motor course (a three-mile track 100 feet wide) without touching ground from start to finish, at an altitude of between 30 and 50 feet, or thereabout, from the surface of the track. This offer is open from the day of the public opening of the motor course until December 31, 1907. A condition is that Edwin Rodakowski, a member of the club, must be given three weeks' notice of an intended attempt to compete, and that the date selected must not clash with any date of racing fixtures. Accommodations for aeroplanes wishing to compete will be provided free of charge.

It has been decided in addition to the above stipulations that the airship must cover the three miles of the course in not less than eighteen minutes, or at the minimum speed of ten miles per hour.

The track, or a portion of it, will be placed by the club at the disposal of those who wish to experiment on certain days in each month, beginning probably in May next.

Prizes for model aeroplanes weighing not over 50 pounds have been offered by the Aero Club of Great Britain for a competition to be held the first part of April. These machines must be able to fly a short distance under their own power. The first prize is $750, and there are two other prizes of $500 and $250 each.

Among the prizes offered for aeroplane flights abroad is a new $40,000 prize for a flight or race from Ostend to Paris. This prize was recently offered by the manager of the Ostend Kursaal, and it is open to both aeroplanes and dirigible balloons. Sunday, the 10th of August, is the date set, and all Sundays in succeeding Augusts till the prize is won. The distance is about 175 miles, and it must be covered within twenty-four hours.

SCIENCE NOTES.

The soapberry tree, *Sapindus marginatus utilis*, has been quite extensively cultivated in Algeria for its berries, which are rich in saponin, and are sent to Germany for use in the manufacture of soap. Similar qualities are possessed by the Florida soap tree, *Sapindus manatensis utilis*, commonly known as the China soap tree, from the fact that it was originally introduced from China. Mr. E. Moulie, of Jacksonville, Fla., has recently been engaged in promoting the cultivation of this tree in the Southern States by a free distribution of seeds. The tree grows to a height of forty or fifty feet and begins to bear fruit in the sixth year. The berries are about the size of cherries and consist of a hard, yellow-brown wax-like shell, inclosing a large black seed. The shell is rich in saponin, and if bits of it are agitated in water a lather will at once begin to form. By grinding the shells a brownsh soap powder is obtained which possesses valuable cleansing properties. The hard, black seeds of the soapberry tree have been used in the manufacture of beads; they also yield a fine oil useful in soap manufacture, as well as in other industries.

As the London Exhibition of 1851 was the time in the middle of the century when technical education began, so the World's Columbian Exposition at Chicago in 1893 marks the beginning of that educational technical movement of which we are now a part. During the last decade advancement has been phenomenal and the demand for technical education never was so great as at the present time. Never has greater attention been given to the subject. England is thoroughly alarmed at the possibility of losing her commercial supremacy. At the organization of the Municipal Technical School of Manchester a committee was sent to the Continent and another to this country to investigate the subject of technical education. Besides individual educators and members of Parliament who have come here, the Mosely delegation of thirty British workmen made an exhaustive study of the industrial situation and technical education. Educators from Norway, Sweden, Russia, France, Switzerland, and Germany have also been attracted to the United States by the remarkable progress we have made. While the presidents of literary colleges are spending much of their time in "stumping" the country, like so many politicians, advertising the advantages of their colleges and making frantic efforts to increase their attendance, the enrollment of the technical schools has been steadily increasing, without pomp or bluster, more rapidly proportionately than the enrollment in high schools, colleges, or universities, and even faster than population. In the South there is clearly apparent an awakening sense of the necessity of more technical skill to develop her resources. The introduction of textile schools, and the application of technical arts in the education of the negro are only forerunners of a great movement for more extended work in other lines. The farmer in the West has learned that the agricultural schools and experimental stations connected with the State universities are of an economic advantage to him and his sons. Mining industries have found that schools of mining engineering, located at convenient centers, are beneficial in supplying their need of trained engineers and metallurgists. The increase of manual training schools in all parts of the country is so rapid that it is difficult to find a supply of well qualified instructors. During the past decade the technical school in the United States which has not largely increased its enrollment, its equipment, and buildings, is decidely the exception. This tendency toward technical education is full of meaning to those who are studying the industrial development only in the educational aspect of the movement.