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, SEPTEMBER 30, 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.

BUILDING THE ERIE BARGE CANAL.

It is gratifying to know that the work of enlarging the Erie Canal to accommodate 1,000-ton barges is fairly under way. Recent reports from the State engineer on the six contracts already let state that on four of them the work is making good progress, and that plants for work on the other contracts have been established. Corps of engineers have been established at fifteen points along the line of the work between Albany and Buffalo, and at each point there is a force of from ten to forty engineers and assistants. Ground will soon be broken on the first canal lock at Waterford, on the Champlain route, and it is gratifying to learn that the Canal Board has decided to make all the locks 45 feet in width instead of 28 feet, as contemplated in the original plan. This is a wise provision which future developments will surely justify. The contracts which are now under active prosecution will involve the expenditure of between five and six million dollars. At present there is an appropriation of ten million dollars at the disposal of the canal authorities, and the Superintendent of Public Works will shortly let other contracts which will cover the balance of this appropriation.

ANOTHER NORTH RIVER TUNNEL.

In addition to the tunnel now under construction beneath the North River for the Pennsylvania Railroad, and the two tunnels now under construction by the Hudson Companies, another influential company is about to construct a new tunnel whose location will be intermediate between those of the Hudson Companies. The Interstate Tunnel Railroad Company of New Jersey, which will build the tunnel, has been incorporated with an authorized capital stock of $7,500,000. The work is to be carried out conjointly by the Metropolitan Street Surface Railway interests, which hope to secure authority to build an extensive system of subways in New York city, and by the Public Service Corporation, which operates all the surface lines in the counties of Hudson, Essex, Passaic, Union, and Middlesex in New Jersey, a total of about 550 miles of line. As part of the scheme, a new direct, high-speed line will be built from Newark, to afford communication, without changing, with the proposed tunnel in Jersey City, and it is proposed to have a schedule which will allow the trip to be made from Newark to the City Hall in New York in fifteen minutes, and between Jersey City and the Manhattan terminal of the tunnel in five minutes' time. The tunnel will run from a terminus in Jersey City at Erie and 12th Street, to a terminus under Chambers Street, between Broadway and the Brooklyn Bridge terminal. Arrangements have been made for a joint passenger station at Jersey City which will enable the Erie Railway Company to transfer its suburban passengers to the new tunnel line.

MAGNETIC SURVEY OF THE NORTH PACIFIC OCEAN.

The Department of International Research in Terrestrial Magnetism of the Carnegie Institution of Washington is about to make a magnetic survey of the North Pacific Ocean. The brig "Galilee," a wooden sailing vessel, has been fitted out at San Francisco for the expedition. The purpose of the expedition is to get exact data of the distribution of magnetic forces over the ocean, the present magnetic charts used by navigators of the North Pacific depending chiefly upon observations made on islands and along the coasts. Observations of this kind are subject to disturbance by local conditions, so that the charts now in use are not trustworthy. It is thought that the work can be accomplished in three years and the sum of $20,000 has been allotted for the expenses of the first year. The "Galilee" will first cruise from San Francisco to San Diego, thence to Honolulu and back to San Francisco. Then a circuit will be made from the west coast of America to the Galapagos Islands, and thence to the Philippine Islands and Japan, returning by way of the Aleutian Islands and closing the circuit at San Francisco. The observations will be continued over a series of areas bounded by parallels of latitude and meridians of longitude each five degrees apart, lying next on the mid-ocean side of the circuit last made, proceeding gradually and by successive circuits into the central region of the North Pacific Ocean. The whole length of the course proposed is 70,000 knots. The work is directed by Dr. L. A. Bauer, who is in charge of the magnetic work of the U. S. Coast and Geodetic Survey. He will accompany the expedition to San Diego. The vessel will carry a sailing master and nine men as crew. The scientific head and commander is J. F. Pratt of the U. S. Coast and Geodetic Survey, who has had thirty years' experience in geodetic, astronomical, hydrographic and magnetic work.

CHAINS VERSUS CABLES IN THE MANHATTAN BRIDGE.

On another page of this issue we publish a letter relating to the Manhattan Bridge, which affords an example of the futility of attempting to solve a complicated question by discussing merely one element thereof. The determination of the relative weight and cost of the cables of a long-span suspension bridge of 1,400 feet and over is so complicated and involves so many considerations peculiar to the type, that there are only a few engineers in this country to-day who have had occasion to master the problem in all its details. We would suggest to our correspondent that the rough-and-ready method by which he arrives at his conclusion that a chain cable for the Manhattan Bridge would cost $4,000,000 more than a wire cable, might raise a reasonable doubt as to whether he was entitled to be included among the few above referred to.

That the weight of an eye-bar chain is greater than that of a wire cable of equal strength, is a fact familiar to all engineers. But to determine just how much is the difference in weight in any given case, is not the simple matter which Mr. Hildenbrand desires to demonstrate. He failed to convince the board of eminent engineers, who passed upon the chain design and unanimously recommended its construction, even after they had listened to our correspondent's arguments.

It does not follow that a chain suspension bridge must necessarily, by reason of its greater weight, cost more than a wire suspension bridge. Moreover, the greater weight and inertia of a chain suspension bridge are most valuable qualities contributory to greater stiffness and durability. This fact was recognized in the design for the Buda-Pesth structure, where the question as to whether eye-bar chain or wire cable should be used, was, we are informed, most carefully considered, purely on its merits, before a final decision in favor of chains was reached.

Comparisons of designs, to be of any value, must be made as a whole, and not on the basis of single features, unrelated to other features. It is not necessary to *guess* the relative values of eye-bar chains and wire cables in the two Manhattan Bridge designs, because they are matters of public record. Plans for both have been worked out and are before us. In the chain design, each chain had a maximum section of 635 square inches and a minimum section of 476 square inches, or an average section of 555 square inches, while the section for the wire cables is given as 275 square inches uniform throughout. Therefore, the sections are very nearly as 2 to 1, that is, the chain cable is about twice as heavy as the wire cable, instead of 4.84 times heavier, as Mr. Hildenbrand desires us to believe. A further corroboration of these proportions is to be found in the total quantities. The weight of the eye-bar chains was published as 14,200 tons, and the weight of the wire cables as round 7,000 tons, both weights including necessary details.

Bearing in mind that in a comparison of costs the whole work, including anchor chains, suspenders, trusses, and roadway must be included in the calculation, and not merely the chains alone, the following facts have an important bearing: The steel tonnage of the superstructure of the Blackwell's Island Bridge, as published, is 42,150 tons, including 6,200 tons of nickel-steel eye-bars and pins, and it was contracted for $5,132,985. The steel tonnage for the superstructure of the chain design of the Manhattan Bridge was published as 45,000 tons, which is only 7 per cent larger than that for the Blackwell's Island structure, although of course, the former includes a much larger proportion of nickel-steel. The character of work for this design was considered by bridge contractors prepared to bid on it to be the same as that for the Blackwell's Island Bridge; that is, typical American pin connections for the chains and trusses, and the erection no more expensive than for that heavy cantilever structure. The cost of the superstructure, allowing for the larger proportion of nickel-steel, could, therefore, have been reasonably expected to be below $6,000,000.

The steel tonnage of the wire cable design is given as 41,700 tons, for which the lowest bid was $7,285,000. Although, as may be seen, the steel tonnage of the Manhattan Bridge is somewhat lighter than that for the Blackwell's Island Bridge, it is, nevertheless, over two million dollars more expensive by reason of the high-priced steel wire cables and other wire work preferred by the present Bridge Department. If to the difference of $1,285,000 between the lowest bid for the wire cable bridge and the very probable cost of the chain design be added the greater cost of the two anchorages for the wire cable design, by reason of the large mass of masonry and foundations, as shown on the plans for the same, then $2,000,000 appears to be a fair estimate of the greater cost of the wire cable design over the chain design.

For a more accurate comparison, strain sheets are essential, because from them only can it be determined whether the computations have been properly made. Strain sheets for the chain design have been published and discussed, and their accuracy has not been questioned. Of the wire cable design no strain sheet has been published, or given out to contractors, which we believe is an unprecedented procedure in American bridge practice. Above all, three facts stand out prominently: First, that the chain design has been approved and recommended for erection by a board of five eminent bridge engineers, and that it was discarded for reasons which apparently will not bear the light of examination by experts; second, that the Department of Bridges declined to submit the new wire-cable design to a similar board of experts for comparison with the discarded chain design; and, thirdly, that the Bridge Department refused to invite bids on both designs. One of the reasons alleged for such refusal was that the plans for the chain design were incomplete. We are informed by engineers who saw them, that the plans are in the same state of completeness as those for the Blackwell's Island structure on which bids were obtained.

The policy of investigating and deliberating on the plans for large engineering work has long been practised abroad; it is now going on with the plans for the Panama Canal; it should be the practice for all costly public works of this country. There can be no greater honor to an engineer than to obtain for his plans the indorsement of a board of leading experts, and instead of opposing such action engineers should solicit it for their own vindication.

TRADE MARKS ON COPYRIGHTED WORKS.

The public has again been reminded of the ineffective remedies afforded by the United States copyright statutes, by the action taken to punish Garrett J. Cauchois for the alleged infringement of a trade mark printed on copyrighted sheet music. The inability to secure redress under the copyright statutes led the proprietor of the copyright to institute criminal proceedings under provisions of the New York Penal Code, making it a misdemeanor to willfully infringe a trade mark. The defense was that the publishers of the music were endeavoring to enforce their copyright rights under the New York trade mark statute, and that if they were entitled to redress their remedy was under the Federal copyright law.

The remedies afforded for the infringement of a copyright are not uniform, and in the case of all works, excepting books and the play right in dramas and musical compositions, the amount recovered for the infringement, which depends on the number of copies of the work found in the possession of the infringer and in some cases the copies which have been sold, is in the nature of a penalty instead of as damages, with the necessity of dividing the amount recovered with the United States. In the case of a musical composition, unlike most other cases where the amount recovered for the infringement is in the nature of a penalty, there is no minimum or maximum amount prescribed which may be recovered, and unless the proprietor of the copyright can find a number of copies of the infringing work in the possession of the infringer, he is unable to obtain redress for the injury occasioned by the infringement. Even then he is unable to obtain satisfaction unless the defendant is in possession of sufficient property to pay the judgment. The infringer is therefore often able to go unpunished, except where a copyrighted drama or musical composition is unlawfully and willfully performed for profit, when the infringer is guilty of a misdemeanor.

The defendant applied for a writ of habeas corpus, which was dismissed by Justice Downing in the New York Supreme Court. In his opinion the justice said that "there was no question in the case of any violation of the copyright law. The prisoner was charged with knowingly selling articles of merchandise, which term included sheet music, to which a false and fraudulent trade mark was affixed. Entirely apart from the property protection itself secured to the author by copyright, there is the protection afforded to any trade mark used by the publisher or seller of copies for public use. If no trade marks were used by the publisher, no crime could be charged herein for merely pirating a copyrighted musical composition, but the

offense charged is clearly a crime within the meaning of the Penal Code."

At this time, when the inconsistencies in the copyright law are being considered with a view to the enactment of a new law in which they will be remedied, it is hoped that Congress will consider the question of the insertion of a provision in the statutes which will make the willful infringer of a copyright subject to such damages and penalties as will act as a deterrent and will make it possible for authors and artists to recover a more reasonable sum as damages for infringements instead of penalties, which are difficult to obtain judgment on and are often small in amount, with the necessity of dividing them with the United States.

VANDERBILT CUP ELIMINATION TRIALS.

Of recent years the elimination trials for the international automobile races have assumed an importance, and excited an amount of interest, second only to that of the races themselves. The elimination trials to select the five machines which are to represent America on the 14th of October next in the annual race for the international trophy, presented by Mr. Vanderbilt, were run off most successfully on September 23. They were held over the same course on Long Island on which the cup race will take place; and the careful work which has been done, in oiling the road and banking the sharp turns, appears to have produced a better race-track and certainly one incurring less risks than that over which the race of last year was held. The starting point was at Mineola, and the first few miles as far as Jericho were over roads that formed a part of last year's course. At Jericho, however, the course turned to the left toward the Sound, and passed through East Norwich, Greenvale, by Lake Surprise, through New Hyde Park, and back to Mineola. In the cup race, ten circuits of the course will be made. In the elimination trials, however, the cars made the circuit of 28.3 miles only four times; the total length of the race, as thus run, being 113.2 miles.

The list of entries included twelve different cars, and of these ten were sent off promptly at two-minute intervals. The starters included a Haynes car, two Pope-Toledoes, a Matheson car, a White steamer, a Locomobile, a Christie, a Royal Tourist, a Thomas, and a Franklin. The fastest time was made by a Pope-Toledo, 60-horse-power machine, which covered the course in 2 hours, 0 minutes, 50 seconds, at an average speed of 56.20 miles per hour, the fastest lap being run in 27 minutes 58 seconds. The next fastest time was made by a 90-horse-power Locomobile, in 2 hours, 1 minute, and 49 seconds. Then followed the 40-horse-power Royal Tourist in 2 hours, 19 minutes, and 18 seconds; the 50-horse-power Haynes in 2 hours, 23 minutes, 32 seconds; and the 60-horse-power Thomas, which made the circuit in 2 hours, 29 minutes, and 40 seconds. A marked feature of the running of the successful cars was that they maintained a remarkably uniform speed, a fact which augurs well for their performance when they compete with the foreign entries over the 283-mile course on October 14.

IS RADIUM THE CAUSE OF THE SUN'S HEAT AND LIGHT?*

BY PROF. G. H. DARWIN.

If, as has been argued, tidal friction has played so important a part in the history of the earth and moon, it might be expected that the like should be true of the other planets and satellites, and of the planets themselves in their relationship to the sun. But numerical examination of the several cases proves conclusively that this cannot have been the case. The relationship of the moon to the earth is, in fact, quite exceptional in the solar system, and we have still to rely on such theories as that of Laplace for the explanation of the main outlines of the solar system.

I have not yet mentioned the time occupied by the sequence of events sketched out in the various schemes of cosmogony, and the question of cosmical time is a thorny and controversial one.

Our ideas are absolutely blank as to the time requisite for the evolution either according to Laplace's nebular hypothesis, or the meteoric theory. All we can assert is that they demand enormous intervals of time as estimated in years.

The theory of tidal friction stands alone among these evolutionary speculations in that we can establish an exact, but merely relative, time-scale for every stage of the process. Although it is true that the value in years of the unit of time remains unknown, yet it is possible to determine a period in years which must be shorter than that in which the whole history is comprised. If at every moment since the birth of the moon tidal friction had always been at work in such a way as to produce the greatest possible effect, then we should find that sixty million years would be consumed in this portion of evolutionary history. The true period must be much greater, and it does not seem unreasonable to suppose that 500 to 1,000 million years may have elapsed since the birth of the moon. Such an estimate would not seem extravagant to geologists who have, in various ways, made exceedingly rough determinations of geological periods.

As far as my knowledge goes, I should say that pure geology points to some period intermediate between 50 and 1,000 millions of years, the upper limit being more doubtful than the lower. Thus far we do not find anything which renders the tidal theory of evolution untenable.

But the physicists have formed estimates in other ways which, until recently, seemed to demand in the most imperative manner a far lower scale of time. According to all theories of cosmogony, the sun is a star which became heated in the process of its condensation from a condition of wide dispersion. When a meteoric stone falls into the sun the arrest of its previous motion gives rise to heat, just as the blow of a horse's shoe on a stone makes a spark. The fall of countless meteoric stones, or the condensation of a rarefied gas, was supposed to be the sole cause of the sun's high temperature.

Since the mass of the sun is known, the total amount of the heat generated in it, in whatever mode it was formed, can be estimated with a considerable amount of precision. The heat received at the earth from the sun can also be measured with some accuracy, and hence it is a mere matter of calculation to determine how much heat the sun sends out in a year. The total heat which can have been generated in the sun divided by the annual output gives a quotient of about twenty millions. Hence it seemed to be imperatively necessary that the whole history of the solar system should be comprised within some twenty millions of years.

This argument, which is due to Helmholtz, appeared to be absolutely crushing, and for the last forty years the physicists have been accustomed to tell the geologists that they must moderate their claims. But for myself I have always believed that the geologists were more nearly correct than the physicists, notwithstanding the fact that appearances were so strongly against them.

And now, at length, relief has come to the strained relations between the two parties, for the recent marvelous discoveries in physics show that concentration of matter is not the only source from which the sun may draw its heat.

Radium is a substance which is perhaps millions of times more powerful than dynamite. Thus it is estimated that an ounce of radium would contain enough power to raise 10,000 tons a mile above the earth's surface. Another way of stating the same estimate is this: the energy needed to tow a ship of 12,000 tons a distance of 6,000 sea miles at fifteen knots is contained in twenty-two ounces of radium. The "Saxon" probably burns five or six thousand tons of coal on a voyage of approximately the same length. Other lines of argument tend in the same direction.

Now, we know that the earth contains radio-active materials, and it is safe to assume that it forms in some degree a sample of the materials of the solar system; hence it is almost certain that the sun is radio-active also.

This branch of science is as yet but in its infancy, but we already see how unsafe it is to dogmatize on the potentialities of matter. It appears, then, that the physical argument is not susceptible of a greater degree of certainty than that of the geologists, and the scale of geological time remains in great measure unknown.

*Abstract from an address delivered before the British Association for the Advancement of Science, Johannesburg, South Africa, August 30.

PATENTS FOR EXPORTED ARTICLES.—PRACTICAL ADVICE TO MANUFACTURERS.

Consul-General Mason contributes a report from Mr. Robert Grimshaw on the importance of securing patents on articles imported into Germany when such articles are patentable. His letter follows:

"I have often had occasion to write American manufacturers and exporters on the subject of having what they have to sell in Europe patented in the countries where they wish to sell them, and in some cases what I have to say has taken effect. But I should be glad of an opportunity to say, for the benefit of manufacturers as a class and for that of American export trade as a whole, some of the things that I have said from time to time to individuals. From the point of view of the manufacturer patenting is desirable, because it prevents the foreigner from doing what he has otherwise every legal right to do at any time that he sees that a foreign invention is meeting with success, and possibly success at his expense, in that it is being sold in his territory and supplanting his own products, viz., make and use of it.

"From the point of view of the selling agent in Europe, who is asked to spend time and money doing missionary work, the desirability of patenting the new thing is evident from the first, and the conviction strengthens with the success of the agent in the unprotected territory. For the manufacturer has at least the protection of home patents, and if through leaving himself unprotected he loses his foreign fields, he has at least his own country to work in with no one to say him nay. But the selling agent abroad, who has put in hard work to convince a very conservative public of the superiority of the new thing (a task which is none of the lightest, especially if there is a marked difference in first cost against the novelty) is cut out completely. This digging wells half down to water is seldom relished even by the most philosophic and philanthropic of agents.

"But when we consider the question solely from these two standpoints we have still by no means got a full view thereof. There is the customer to consider. He does not want to buy a lawsuit with a machine or other purchase. In case the article to be sold is not patented in the country in which it is offered for sale there is the danger that it has already been patented by another, and that the patentee will very justly bring against the purchaser an action for infringement of his chartered rights. In this danger the resident agent—the missionary—participates. It is useless to assure the customer that the manufacturer is one of the largest concerns in his native country, and will protect the purchaser against any possible suits for infringement. In the first place the customer has no means of verifying the statement about the financial weight of the manufacturer, and in the second he does not care; he does not wish to be annoyed by any suits, no matter how heavily he may be backed up. In the third place, if he knows anything about German patent law, and the case is a German one, he will quietly remind the missionary that in that country the infringement of a patent is not merely a civil but a criminal offense; and no manufacturer in America, however influential in financial circles, can get around that part of the difficulty. Section 36 of the German patent law of April 7, 1891, says: 'Whoever knowingly uses an invention contrary to the ordinances in sections 4 and 5 will be punished with a fine of 5,000 marks or with imprisonment not to exceed one year.' The quoted sections 4 and 5 are those which secure to the inventor the sole rights of the invention which he patents.

"Further, there are many manufacturers who seek to convey to their agents and to the customers the impression that the matter is patented in the country of sale, not by directly saying so, but by implication. Sometimes this implication is only one of silence; but for all that the attempt, whether unlawful or not, is dangerous in most countries, and especially in Germany. For section 40, of the law already quoted, says distinctly that whoever marks objects or their packages with any sign calculated to impress one falsely with the idea that the object is patented according to the German law shall pay a fine of 1,000 marks. I had been for months in correspondence with the European general agency of an American manufacturer. To get a definite answer, or even any answer at all as to patents, was next to impossible. At last, however, I got the following: 'Our friends, the ———— Company, apologize for the delay in answering our letters about patents, which they say has occurred through oversight. They write: "As you may be aware, probably we have a great number of persons applying for patents in our own and foreign countries, and to possess you of definite information concerning them would be rather a difficult matter. It will, however, suffice and be entirely satisfactory to you to say that we will fully protect our customers against damages resulting from any lawsuits brought against them by reason of the use of our devices."'"

THE CURRENT SUPPLEMENT.

Dr. Alfred Gradenwitz opens the current SUPPLEMENT, No. 1552, with an article on Improved Methods of Tele-Photography, illustrating his article with actual photographs. Hydrocarbon Oils and Their Value as Lubricants has been taken as the subject of a very thorough article by Frank Harris Floyd. Unquestionably one of the most important investigations in physiological chemistry at the present time is the study of soluble ferments. These are briefly and yet comprehensibly reviewed by Mr. J. H. Long. While there are but few scientific workers who are not more or less expert photographers, few of these possess an adequate knowledge of the laws which define the reactions of the photographic dry plate. For such, a paper by C. E. Kenneth Mees, on the Testing of Photographic Dry Plates, will prove of exceptional value, inasmuch as the paper is both exhaustive in its treatment and copiously illustrated. Robert H. Smith writes on High-Speed Steam and Electric Railways. Albert Mann presents a scientific and yet an absorbingly interesting account of Diatoms, supplementing his text with many excellent illustrations. Clarence M. Weed gives the result of some experiments in destroying black flies. Sir William White writes on submarine signals. A thorough article on the first producer-gas boat is published, which fittingly describes one of the most noteworthy technical achievements of recent years. Sir William Crookes's article on Diamonds is continued.