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The Docks at Skagway, the Starting Point of the White Pass and Yukon Railroad.

THE MOST WONDERFUL RAILROAD OF THE NORTH.—**[See page 29.]**

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NEW YORK, SATURDAY, JANUARY 11, 1908.

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.

IMPORTANT CHANGE OF PANAMA CANAL LOCKS.

The Panama Canal Commission has decided upon an important revision of the plans for the locks near the Pacific terminus of the Panama canal, which will result in considerable economy, and will place the locks in a much better defensive position. The earlier plans provided for the construction of two large dams, one the La Boca-San Juan, a mile in length, the other the Soza-Corozal dam, a mile and a quarter long. These structures would have formed a lake, two miles wide and four miles in length, and would have necessitated the relocation of the Panama Railroad and the building of a spillway from Soza Lake to the sea.

The new plan calls for the construction of a single dam at Miraflores, only half a mile long, in which will be built the two locks, by which ships will be raised from sea level to the 55-foot level. A channel 500 feet wide will lead from the locks to the Bay of Panama, and this channel will lie in material that can be excavated entirely by dredges. Another advantage of the change is that the Miraflores dam will be founded everywhere upon rock, which the numerous 6 by 8 feet test pits have shown to be present throughout the whole site. The change will also lead to some economy of time in transit, since ships will be able to steam at good speed through the 500-foot channel, direct from the sea to the locks.

The importance of the change can scarcely be overestimated. The security of the canal is greatly increased by the removal of the dam and locks some four miles farther out of the range of an enemy's guns; the target is much smaller; and it is estimated that because of the reduction in size of the works and the greatly reduced depth to rock foundations, there will be a total saving of about eight million dollars over the former plans.

OUR DECADENT MERCHANT MARINE.

Admiral Dewey, in a report prepared in 1905 at the request of the Merchant Marine Commission, stated that on the basis of a strength of twenty-seven battleships, the United States navy in a serious war would require from the merchant marine approximately one hundred vessels, in addition to a large number of tugs. At the present time our navy includes exactly that number of battleships; yet in the whole merchant marine we could not possibly secure the necessary number of vessels of the larger size called for in Admiral Dewey's report.

If proof of this were wanted, we have it in the conditions attending the dispatch of the Pacific fleet of sixteen battleships around Cape Horn; for the coal necessary for this fleet (except a small portion carried by our regular navy colliers) is being shipped to the various coaling places in foreign tramp steamers. Although the President offered to pay American ships a rate fifty per cent higher than that paid to foreign vessels, American steamships could not be secured. A numerous merchant marine, capable of furnishing a large reserve of trained officers and men, is absolutely indispensable, if the full efficiency of a country's navy is to be realized. According to the Assistant Secretary of the Navy, England to-day has at least one hundred merchant colliers, aggregating 400,000 tons capacity, immediately available in the event of war; whereas, the United States, in spite of the fact that it has now risen to the position of second naval power in the world, would be very gravely handicapped by the lack of a fleet of sea-going merchant ships and of a qualified reserve of officers and men.

We cannot shut our eyes to the fact that the merchant marine of this country, which at one time was the most numerous and efficient in the world, is, to-day, at least in some parts of the high seas, in danger of absolute extinction. Proof of this is found in the conditions in the Pacific. Twelve months ago there were fifteen large American steam merchantmen plying upon the Pacific Ocean; to-day only eight of these are left, and at this rate of retrogression the absolute extinction of our merchant ships, at least on that ocean, is only a question of time. The decadence of our merchant marine is mainly due to the facts, first, that we cannot build merchant ships as cheaply as they are built abroad; and, secondly, that because of the higher pay and better food of the American seaman, it costs us a great deal more to run our ships. If we are to establish steamship routes, and place upon them steamers which in point of speed and accommodations are the equal of those owned by foreign countries, it is absolutely necessary that some sort of government assistance be rendered, particularly as the competing lines are already themselves, in many cases, heavily subsidized. The Assistant Postmaster-General, in explaining recently why the Post Office Department is in favor of a subsidized merchant marine, stated that the government received last year for carrying the mails to foreign countries over $6,500,000, of which more than $3,500,000 was profit. He further stated that if the government were willing to forego this profit, and to have the mails carried by its own citizens instead of by foreigners, this six and a half million dollars of postal receipts would provide at a minimum cost the necessary naval reserve.

PREVENTION OF "FLAREBACKS" IN MODERN GUNS.

Unquestionably the greatest risk incurred by those who handle modern ordnance is due to what is known as the "flareback." It is a danger which has always been present in the English navy; in our own navy it has been responsible, during the past seven or eight years, more or less directly, for the deaths of over half a hundred men; and not long ago, during the firing of a 10-inch gun on the new Japanese battleship "Kashima," there was a flareback which ignited a powder charge, and resulted in the death and injury of over forty officers and men. The causes of this peril are well understood. When a gun is discharged, a large quantity of gas, chiefly carbon monoxide, remains in the bore of the gun. As long as the breech remains closed, this gas does not ignite, for the reason that there is not sufficient oxygen present for combustion; but upon the opening of the breech for the insertion of the next charge, this gas is frequently blown out by the back draft passing through the gun, and meeting with the necessary oxygen in the air, it is ignited, and bursts into a flame which is frequently of great magnitude. One of the officers of our navy recently described a flareback, in which the flame rose and spread out for a considerable distance under the roof of the turret.

For the prevention of flarebacks, the navy now introduces a blast of air at the breech before it is opened, for the purpose of expelling these gases, driving them out through the muzzle of the gun. The ordnance officers of the army, which is not troubled with flarebacks, claim that the difficulty can be eliminated entirely by enlarging the ignition charge of black powder. If this be done, there is a more complete combustion of the gases, particularly of the dangerous carbon monoxide. We understand that the navy is adopting this method with good results.

The Germans have taken up the subject with their characteristic thoroughness, and have produced a powder which is said to give no flareback whatever, even in guns of the largest caliber. The composition of the powder is not known, but it is supposed to consist of nitroglycerine, nitrocellulose, and vaseline. The prevention of the flareback, however, is believed to be due to the incorporation in the powder of a small amount of some chemical which has proved to be thoroughly effective. Next to the problem of gun erosion, this is the most serious of those which confront the artillery expert. Apart from the actual loss of life, which in our own navy has reached the proportions of a calamity, it is certain that the existence of this menace must produce a certain amount of nervousness at the very time of all others when the gunner should have his eye and hand in perfect control.

WARSHIP CONSTRUCTION AT OUR NAVY YARDS.

Popular fallacies die hard, especially when they are kept alive by persistent and interested misrepresentation. A notable instance of this is the statement so often made, and too widely believed, that it costs a great deal more and takes considerably longer to build a battleship at a government navy yard than it does at a private shipyard. There was a time, it is true, when navy-yard-built ships were very costly, and took an unconscionable time to complete; but that was over twenty years ago, when political control of navy yards was rampant, and before a certain courageous young naval constructor, who later became Chief Constructor of the Navy, undertook the task of rescuing our navy yards from political control, reforming their many abuses, and putting them in first-class working shape. It was the regeneration of these yards which rendered it possible for them to take hold of the highest class of naval work and complete it in the same time, and for only slightly more cost, than the best of our private yards. This was clearly proved, some years later, in the construction of the large, modern battleship, the "Connecticut," at the New York navy yard, when the work was carried through so expeditiously, that the private yard which had taken the contract for the sister ship, had to extend itself to the utmost to keep pace with the government-built ship. One of the main objects of giving work of new construction to the navy yards was to spur the private builders to greater activity; for up to that time it was a notorious fact that the government contract work was treated as a kind of standby in the private yards, the first attention being given to orders for private firms. The record made by the "Connecticut" for rapid construction has acted as a most effective spur to the private yards, and our latest warships, in spite of their greater size, are being built in from fifty to sixty per cent of the time taken to build the earlier ships.

The agitation in favor of navy-built ships originated within the navy itself, and its most effective advocate was the naval constructor above referred to, Mr. Francis T. Bowles, who subsequently left the navy, and is now the president of one of the great shipyards upon which the government depends mainly for the construction of its new navy. The most complete and convincing presentation of the arguments in favor of navy-built ships, is that made by Mr. Bowles in the year 1900, before a congressional committee on naval affairs appointed to consider this question. Just now, when the question is again being agitated, it would be impossible to find a better brief for the case than this testimony of the former constructor.

In his evidence before the committee, Mr. Bowles stated that the first advantage of building ships in navy yards is that it maintains the efficiency of the mechanical force and of the plant and shops. "The reason that we have navy yards is to provide ourselves with the means of equipping and keeping our ships in good order for purposes of war; and, with that end in view, and in the light of our recent experiences, it is essential that the organization of a mechanical force and the equipment should be kept in an efficient condition.

"Now, if, in these yards, which are essential to the object of the navy, we should keep a vessel or two vessels building all the time, we would have a nucleus of a complete force, and it would be necessary, in order to do that work with a reasonable degree of economy, that our yards should be kept in good order.

"The fact that a vessel is building in a navy yard makes it possible to conduct the repair work of the fleet economically and rapidly; because, if a vessel comes in for repairs, as soon as it is determined what it is necessary to do, the force is available, and every shop is in working order, and the chances are that there is a stock of material on hand of every kind that would be needed to make those repairs. The matter of having the material on hand is one of the most essential items in carrying on work rapidly.

"The third advantage is that the amount expended for repairs will be reduced by the fact of having ships building in the yard. That may seem a curious thing, but it is perfectly true that if you have got enough to do to keep an efficient force at work, there will be no tendency whatever to magnify repair work, or even to devote attention to considering what improvements can be made in existing ships.

"The fourth advantage in carrying on new work in the navy yards is that it enables the government to maintain a high standard of workmanship and design, by which the contractors can be made to conform to what is necessary under their contracts, and I consider this a great advantage.

"I will combine that with the fifth item on my list: that building ships in navy yards provides a training for those who must inspect the contract work. I maintain that a man is unfit to be a government inspector, to tell the contractor how his work shall be done and what is acceptable and what is not acceptable, unless he has had that kind of work himself.

"The next advantage to the government in doing the work is that no profit has to be made. The cost of inspection can also be saved. When a ship is built by contract, the government maintains a force of inspectors and draftsmen, who inspect the work in progress and make projected plans. The cost of a trial trip is another item saved, for it is the custom to remunerate the contractor, either by including it in his contract, or fairly, as an extra bill, for all the expenses of the trial trip."

Now, since the above telling arguments were presented—and they are just as valid to-day as when they were made—the question, as we have noted above, has been put to the test by the construction at Brooklyn of one of a pair of the largest battleships so far built for our navy; and the question naturally arises, How far have the predictions of the former Chief Constructor been verified? In answer, it can be said that the "Connecticut," in spite of the strenuous efforts of the private firm which was building the sister ship "Louisiana," was completed within the same time as that ship, and within two or three months less time than called for by the contract. Because of the fact that hours are shorter, and the pay somewhat higher in the government yards, no claim was ever made that the "Connecticut" could be built as cheaply as the "Louisiana." It was estimated that she would cost about ten per cent more than the other ship. As a matter of fact, in the final summing of the costs, it was found that she cost only five per cent more. The latest official report of the Navy Department gives the total cost of the two ships to September 30, 1907—the figures including the expense of alterations chargeable to original construction, and also of armor and permanent ordnance fittings—as follows: For the "Connecticut," $6,367,308.22; for the "Louisiana," $6,037,-344.47.

The question may be raised as to whether as good a ship can be built at our navy yards as at the private yards. Perhaps the most conclusive test of this point is to compare the actual cost of repairs on these two ships since their completion. Fortunately, the figures are available; for the same report gives the cost of such repairs for the "Connecticut" as $94,314.56, and for the "Louisiana" as $110,500.19, a difference of about 17 per cent in favor of the "Connecticut." As a matter of fact, the comparison is more favorable than appears on the face, and this for the reason that the totals for the "Connecticut" include repairs made necessary by her having been run aground during the past summer, an accident which, of course, is in no sense chargeable to the quality of the work of the ship itself.

In regard to the five per cent increased cost of the "Connecticut," it is but fair to draw attention to the fact that, this being the first large battleship to be built at the Brooklyn navy yard, there are several items of cost charged to her, which would not appear against any subsequent battleship built upon the same ways. These are expenses due to work of a preparatory kind; to the provision of special tools in the machine shops and special appliances in the yard, which, once built, will be available for subsequent ships.

Thus, the preparation of slip, cribbing, and scaffolding cost over $39,000 for the "Connecticut," as against $12,000 for the "Louisiana;" so also the cost of preparing launching ways and launching the ship cost over 100 per cent more for the navy yard ship. There would be no such difference in the case of the next battleship to be built on these same launching ways. Again, in the preparation of beds and erecting, the list shows a cost of $12,000 or about 100 per cent more for the "Connecticut." This item probably refers to the beds on which the engines were built; yet these beds are now a part of the permanent plant of the erecting shop, and indeed, are now being used for building the engines for the collier "Vestal." It would be possible to follow this comparison further if we had time, and show that if the cost of these preliminary preparations and of special tools and appliances were charged to the plant of the yard, to which they properly belong, the difference of five per cent between the "Connecticut" and "Louisiana" would be not a little reduced.

A NEW COIN COUNTER.

A new coin counting device has been perfected, which is claimed to possess several advantages over the older forms of this machine. In brief, the new coin counter assorts, counts and delivers accurately in regulation bank packages, nickels, dimes, quarters, and half-dollars, and in one-fifth to one-tenth the time necessary to do the work by hand. All the operations are carried on simultaneously and the machine is complete in itself, no extra parts being necessary for the manufacture of wrappers, or for any other portion of the work. The amounts in the packages may be varied to meet the requirements, and every coin can be followed by the operator from the time it enters the apparatus until it is delivered and counted. Canadian nickels, 20-cent pieces, and quarters, and badly mutilated coins of our own money, are automatically sorted out and rejected.

THE ECONOMIC WASTE OF ACCIDENTS.

A friend of the American Museum of Safety Devices and Industrial Hygiene has offered a prize of $100 for the best essay on the Economic Waste of Accidents. The committee of award consists of Richard Watson Gilder, George Gilmour, and W. H. Tolman. Prof. F. R. Hutton, past president of the American Society of Mechanical Engineers, is the chairman of the committee on admission of exhibits for the American Museum of Safety Devices and Industrial Hygiene, which occupies the entire fifth floor at 231 West 39th Street, New York. The museum desires exhibits of devices and processes for safeguarding life and limb in connection with woodworking machinery, railway and marine transportation, mining, agriculture, manufacturing of all kinds. One exhibit already consists of specimens of fifty different kinds of dusts, illustrating the occupational diseases; accompanying each is a photograph of a microscopic section of the lungs showing the effect on the worker of coal, iron, brass, steel, wood, and other dusts. There are also wax models of lungs and hands illustrating those occupational diseases which attack the bones and skin. All exhibits accepted by the committee on exhibits will be eligible for the gold medal offered by the SCIENTIFIC AMERICAN for the best device, exhibited at the museum, for safeguarding life and limb. All inquiries regarding exhibits should be sent to Dr. W. H. Tolman, director, 231 West 39th Street, New York.

HABITS OF THE TARANTULA.

BY C. E. HUTCHINSON.

The great tarantula of the southwestern part of the United States, like many another poisonous creature, as well as some that are quite harmless, is much maligned. It is not aggressive upon man, nor is it often intrusive, though many an old miner or prospector has "shaken them out of his blankets or boots in the morning." Strange to say, tarantulas thus dislodged are usually "the size of a saucer."

It is often stated that the spider frisks about in the sunshine on the hot sands of the desert, but in reality it avoids sunshine when it is hot, and remains well down in its burrow in the ground. About sundown, it comes up to the opening and lies in wait just below the surface. It assumes this position whether it desires food or wishes only to get a bit of fresh air. It does not travel about in quest of food, even when hungry, but remains quietly in the attitude described, often for hours at a time. At the near approach of a caterpillar, grasshopper, beetle, or almost any creature of like size, other than its enemy the wasp, it rushes out and seizes it; but rarely goes farther than a few inches from the opening. Should the prey, when first arrested, simulate death, which often is the case, since usually it is not at once wounded, the spider, unless it is very hungry, remains quiet until the insect moves, when the needle-pointed fangs are thrust into it. By pausing, it learns the nature of the object seized. The spider then retreats with it into its burrow, to feast, where the prey is ground up by the powerful mandibles, and the liquid portion, upon which the spider subsists, is sucked out. One fair-sized insect a week is sufficient to satisfy its hunger, because of its inactive existence, while it can live several months without food, even when most active, provided it has water. The spider will fight and destroy its own kind, but when equally matched the combatants spar for an advantage and rarely clinch unless one relinquishes its vigilance, when the other buries its fangs in it. It does not then relinquish its hold until the helpless captive dies of paralysis, induced by the poison injected. Death results in ten or twenty minutes. There are approximately seven or eight females to each male. The adult males are highly energetic and, unlike their phlegmatic mates, cannot be kept long in confinement. They wear themselves out in ceaseless endeavor to escape. This striking degree of activity is an essential attribute, since the females live often remote from one another and take no initiative in the courtship.

The tarantula does not dig its own tunnel. It takes possession of some deserted burrow, usually that of a pocket gopher, which to the adult spider seems highly satisfactory. These burrows run, for the most part, horizontally, but the spider enters through a short vertical shaft. The burrows are two or three inches in diameter, but the spider at once restricts the entrance nearly to the diameter of its own body. It does this in a singular and interesting manner, affording a striking example illustrating the wide resourcefulness of lowly creatures. The spinnerets are two flexible and movable processes upon the under side of which are long rows of pores from which the silk is drawn out in a multiplicity of frail threads. With these organs, free particles of earth on the floor of the burrow are covered with a frail gauze which is then wadded together, along with much of the loose earth, which adheres to it. The wad is then carried up and pressed against the vertical wall, where it adheres, when it is further secured in place with more silk. The wads may be a half inch in diameter, and often many are required to finish the task.

In autumn, the spider closes the entrance completely in this manner, frequently using a large quantity of material. It is then ready to pass the winter in a semi-lethargic state, partaking of no food. In the spring it digs its way out. If the burrow is still in good condition it is cleaned out, the refuse being placed in a circle about the opening, where it renders the abode conspicuous. If the burrow proves untenantable another one is sought at once. There is evidence tending to show that the spider does not seek another habitation as long as the old one is suited to its needs; and quite often a number have been found that had lived at least three years in one place, judging by the number of discarded skins of suggestive size found in the burrow. During the growth of the tarantula, which requires about twenty years, it sheds its entire skin once each year—in mid-summer. The event is an important one to the spider, and as it is then quite helpless, the entrance is previously closed, a sheet of silk drawn across it sufficing.

In June two or three hundred eggs are produced in a mass which is at once covered with silk. The tunnel, unlike that of the trap-door spider, is not lined with silk; therefore to guard the eggs against contamination, while they are uncovered, the spider first incloses itself in a silk bag, sufficiently large to allow it to turn around freely. I think that this feature has not before been described. The discovery was made by watching spiders in captivity, numerous brief inspections having been made at suitable intervals. The subject's aversion to light and to being disturbed at this period is quite apparent, and any prolonged or too frequent inspection causes it to abandon the task, so the entire operation cannot be learned from a single spider. Unless it is captured within a few days of the time that the cocoon is to be made, the spider makes no effort whatever to preserve the eggs. The large envelope inclosing the spider is quite frail, but its distension is insured by attachments to the wall of the burrow; and while it is very thin it is so closely woven that the finest dust is excluded. The floor of this silken cell is raised a little above the floor of the burrow. Soon after the egg mass is properly inclosed in its covering, the fabric inclosing the spider is torn away. The finished cocoon is over an inch in diameter and shaped like a depressed globe. The young emerge from the cocoon in midsummer and, after shedding their skins, are found to be the size of a house fly divested of its wings. They remain during the summer in the maternal domicile, seemingly a happy family; but in autumn they leave, one by one, each seeking some hole, suited to its size, which it proceeds to clean out and barricade in conventional manner. Nature will favor two, perhaps, out of as many hundreds, and protect them until they die of old age, at the end of twenty-five or thirty years.

OFFICIAL METEOROLOGICAL SUMMARY, NEW YORK, N. Y., DECEMBER, 1907.

Atmospheric pressure: Highest, 30.46; lowest, 29.16; mean, 30.01. Temperature: Highest, 58; date, 23d; lowest, 19; date, 5th; mean of warmest day, 54; date, 10th; coolest day, 25; date, 5th; mean of maximum for the month, 43; mean of minimum, 32.7; absolute mean, 37.8; normal, 34.1; excess compared with the mean of 37 years, +3.7. Warmest mean temperature of December, 42, in 1891. Coldest mean, 25, in 1876. Absolute maximum and minimum for this month for 37 years, 68 and —6. Average daily deficiency since January 1, —0.6. Precipitation: 3.91; greatest in 24 hours, 1.35; date, 14th and 15th; average of this month for 37 years, 3.39. Excess, + 0.52. Accumulated excess since January, 1, +0.71. Greatest December precipitation, 6.66, in 1884; least, 0.95, in 1877. Snowfall, 4.4. Wind: Prevailing direction, west; total movement, 10,419 miles; average hourly velocity, 14 miles; maximum velocity, 56 miles per hour. Weather: Clear days, 7; partly cloudy, 13; cloudy, 11; on which 0.01 inch, or more, of precipitation occurred, 10. Sleet, 14th. Fog (dense), 23d, 30th.

THE CURRENT SUPPLEMENT.

The current SUPPLEMENT, No. 1671, contains an unusual number of instructive and interesting articles. Albert Wells Buel reviews the recent advances which have been made in reinforced concrete engineering. How tannery wastes may be utilized is a technological contribution of value. Within recent years the use of mechanical devices for agricultural purposes has developed markedly. The most recent advance of this kind has been described by the English correspondent of the SCIENTIFIC AMERICAN under the title of "A New Agricultural Oil Motor." W. H. Booth contributes a very good criticism of the gas engine cycle. Sir William Ramsay, well known for his discovery of helium and his recent radioactive investigations, writes a semi-popular article on the effect of radium emanation, in which article he briefly dwells upon his recent discovery that radium emanation has the marvelous property of degrading certain elements. One of the most helpful articles which has appeared in the SUPPLEMENT for a long time is one from the pen of the Paris correspondent of the SCIENTIFIC AMERICAN, in which he describes the recent French aeronautical motors. As most of us know, French engineers have produced types of motors which are extremely light and very efficient, in fact engines which fall but very little short of the ideal prime mover for the aeroplane and the dirigible balloon. For that reason the article in question should be read by all aeronautical experimenters.

WINTER FIRES.

BY DAY ALLEN WILLEY.

The photographs which accompany this article forcibly illustrate the great disadvantage when water is employed for fire extinguishing. These scenes are not unusual, as any reader who has seen the ruins of burned buildings in the winter season will admit. When the temperature gets below the freezing point, water loses much of its effect, since it congeals except where it is in rapid motion. When the temperature goes below zero, as is so frequently the case in our northern cities, the obstacles which must be overcome by the firemen are very great. One of the common sources of trouble is the freezing of the hydrant from which the supply may be obtained. The smallest leak at the joints of the hose quickly forms an ice coating, and if there is much waste water on the ground, the hose may be so incased in ice that it must be cut out in order to be handled. At times the ice actually forms around the nozzle to such an extent as to greatly interfere with the force of the jet.

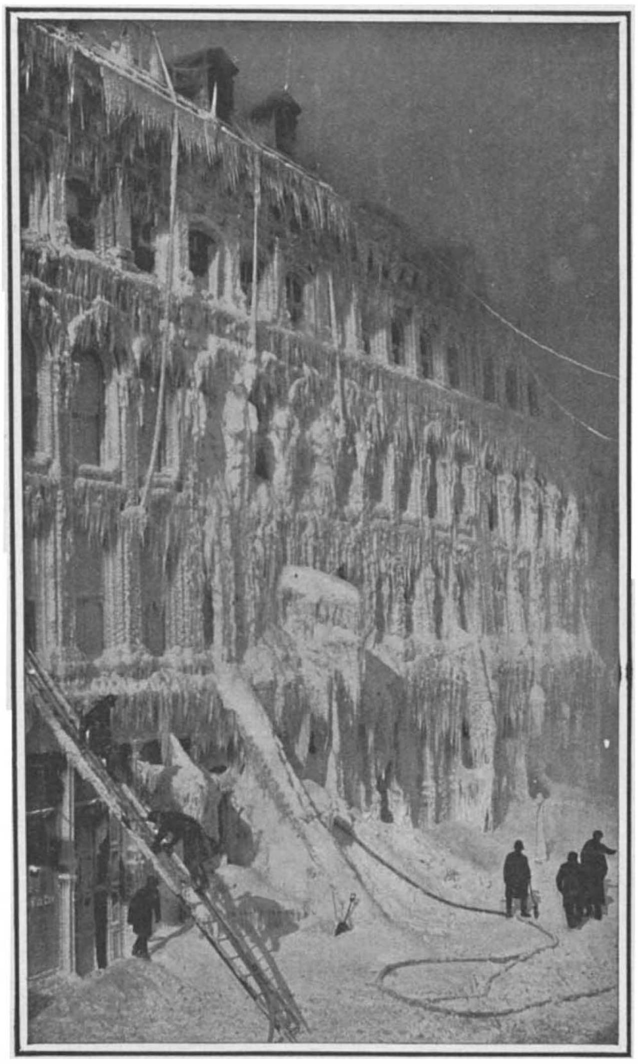
We are familiar with the enormous waste of water in extinguishing fires—the quantity which does not reach the fire itself, and may fill the cellar of the burning building and flow upon the street. Experts have calculated, however, that from 60 to 90 per cent of the discharge from hose pipes is non-effective. In winter this becomes really a menace, since it turns to ice so rapidly. With the mercury around the zero point, every drop which falls upon a part of the building which is not warm enough to evaporate the moisture, turns to ice. When a dozen or more engines are each throwing from 500 to 1,000 gallons a minute upon the walls, through the windows, and over the top of the structure, it is not strange that the fire is sometimes protected by ice walls to such an extent that holes must be cut through several feet of ice in order to put the water from the jets directly on the fire.

Every schoolboy knows that many a common element is a natural fire extinguisher. They include such substances as soda, salt, potash, alum, and borax. The chemical engine, as we call it, is merely a metal tank filled with soda water, into which sulphuric acid is injected when it is needed for use. It seldom carries over 100 gallons of the liquid, but its action on a fire is so pronounced that it has become a part of every modern fire department, and in many villages is the only piece of fire apparatus in service.

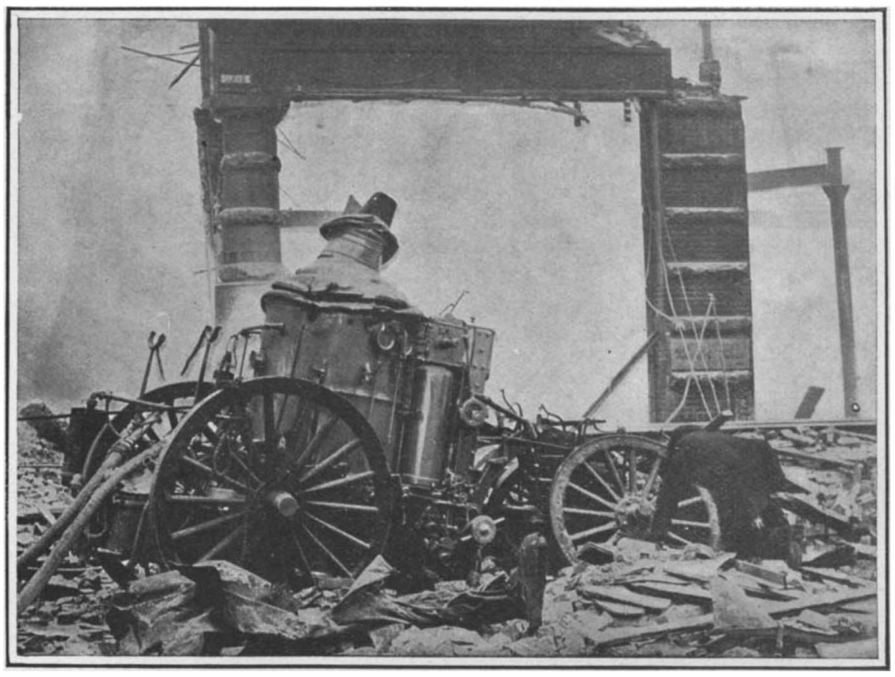
Even the small stream thrown by the hand extinguisher carried by the fireman on his back does such execution that this apparatus is carried in the hose wagon. The reason why the soda water is so efficient is that it forms a film or crust upon the burning mass, and by keeping the oxygen of the air from being drawn into it, smothers or stifles the fire, preventing it from feeding upon the oxygen. There are so many possible combinations which could be utilized for the same purpose, either in the form of liquid or gas, that some inventor who is an expert in chemistry should give a substitute for water, or at least a liquid which would be a powerful auxiliary to it. The elements we have named, as well as others, can be obtained in such quantities that the cost of such a composition should not prevent it from being prepared in sufficient quantities to be used on a large scale. Experts agree that a gas or a liquid could be manufactured and stored safely in reservoirs properly protected, and that no reason exists why the compound should not be distributed through piping, possibly ejected by means of powerful pumps, as in the case of high service water systems. The modern hose would be strong enough and sufficiently impervious to carry the gas or liquid, so that it could be utilized at a fire in the same manner as water is now employed.

Apparently the principal problem to solve is that of the chemist in obtaining a solution which, while suitable as a fire extinguisher, will not be so affected by low temperature as water, and will accomplish much greater results in proportion to the quantity used. When we remember that a pound of wood contains enough heat units to evaporate a gallon of water, it is not strange that in conflagrations a score or more engines may throw 25,000 or 30,000 gallons of water every minute upon the fire yet have no appreciable effect, on account of the intense heat caused by the large quantity of inflammable material which may be afforded merely by the floors, window casings, and interior finish of the so-called fireproof building.

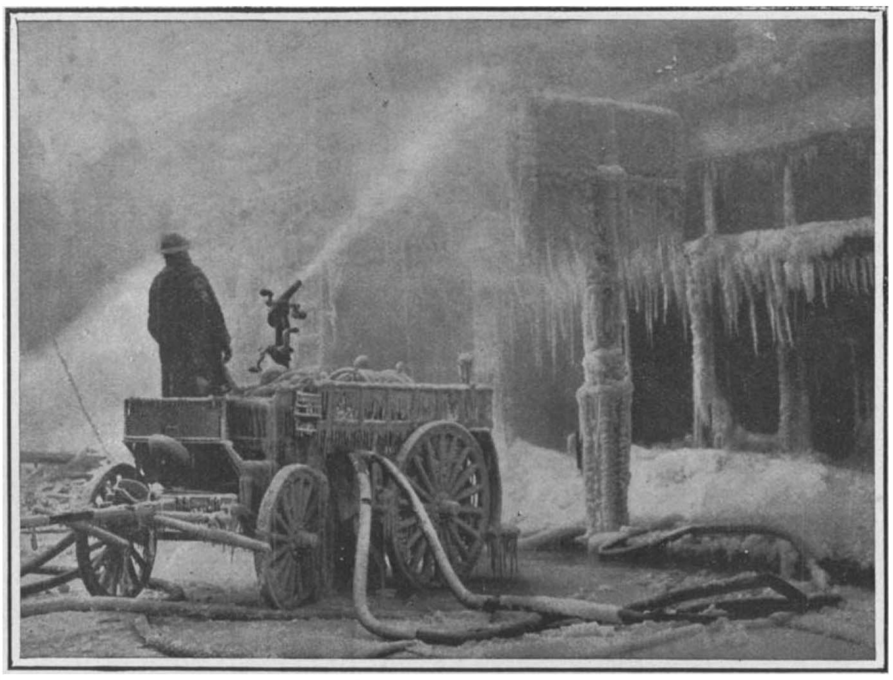
The enormous saving which would be effected by a practical substitute for water, or one which could be employed on a large scale in connection with it, can be appreciated when the fire loss in recent years is considered. The series of great fires beginning with that of Chicago and ending with the San Francisco disaster caused a loss aggregating no less than six hundred million dollars. It is a fact that within the last twenty-five years the total fire losses have amounted to three and one-half billion dollars, or nearly one million more than the greatest public debt which the United States has ever incurred at one time. Surely, there is an opportunity for the chemist to give practical help by improving upon the element upon which we now depend.



In Zero Weather the Water Freezes as It Falls, Covering the Ruins with Thick Layers of Ice.



Falling Walls or Beams Are a Source of Danger.



The Hoses Themselves Are Often Incased in Ice.

A Frequent Source of Danger; Mere Shells of Walls Are Often Left Standing, and These at Times Collapse Without the Slightest Warning.

WINTER FIRES.

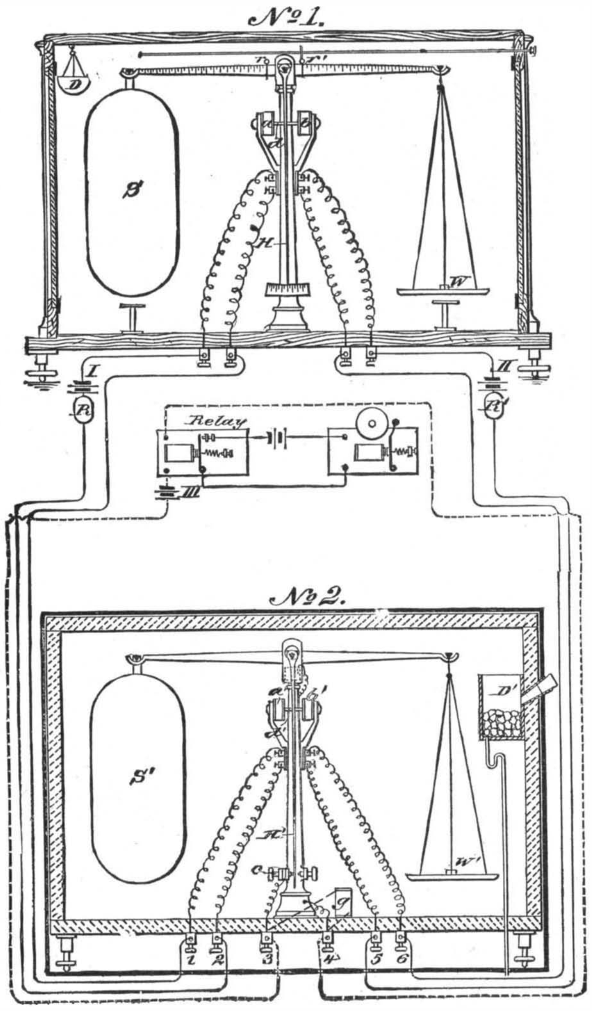
According to L'Electricien, a Vienna firm has recently placed on the market brushes made of glass, which are to replace emery cloth for cleaning and polishing the commutators of dynamos and motors. These brushes are said to clean the commutators without scoring the metal, and their use avoids the inconveniences and dangers of emery cloth.

AN APPARATUS FOR INDICATING FIRE DAMP IN COAL MINES.

The very startling accounts of mining disasters which have recently found their way into the press induce the Editor to present once more to his readers an ingenious apparatus invented some years ago by Mr. Henry Guy Carleton for the purpose of indicating firedamp in mines and of thereby averting at least one source of danger to the miner. The apparatus consists, essentially, of one or more indicating balances to be permanently placed in a goaf or drift of the mine, and a registering balance to be used by the observer in the testing room, connected by wires. Each balance holds in equilibrium a thin glass bulb of about 300 cubic inches capacity, hermetically sealed. They are counterbalanced at the same moment by the weights, *W* and *W'*, respectively, and hence will be equally affected by variations in the atmospheric pressure. Attached to the vertical arm or pointer, *H*, of each balance is a soft iron needle, *d*, gilded to prevent rusting. Its ends plunge freely into helices of insulated wire, *a* and *b*.

The helices on both instruments are exactly of the same size and electrical resistance, and of sufficient internal diameter to exert but feeble influence on the needles with an ordinary current. The right-hand helix of balance No. 1 is connected with the right-hand helix of balance No. 2, and is supplied at will from battery II. with a current whose strength can be lessened gradually and delicately by resistances thrown into the circuit by the rheostat, enabling the magnetic force of the helices to be regulated to a nicety. The left-hand helices are similarly connected, through battery I. and rheostat. (See diagram.)

The vertical arm, *H*, of balance No. 2 has a platinum tip capable of electrical contact with insulated screw, *c*. Connection from binding post 4 to the vertical arm is made by means of the mercury cup, *m* (see engraving), into which a wire from the beam is



Instrument for Indicating Fire Damp in Mines.

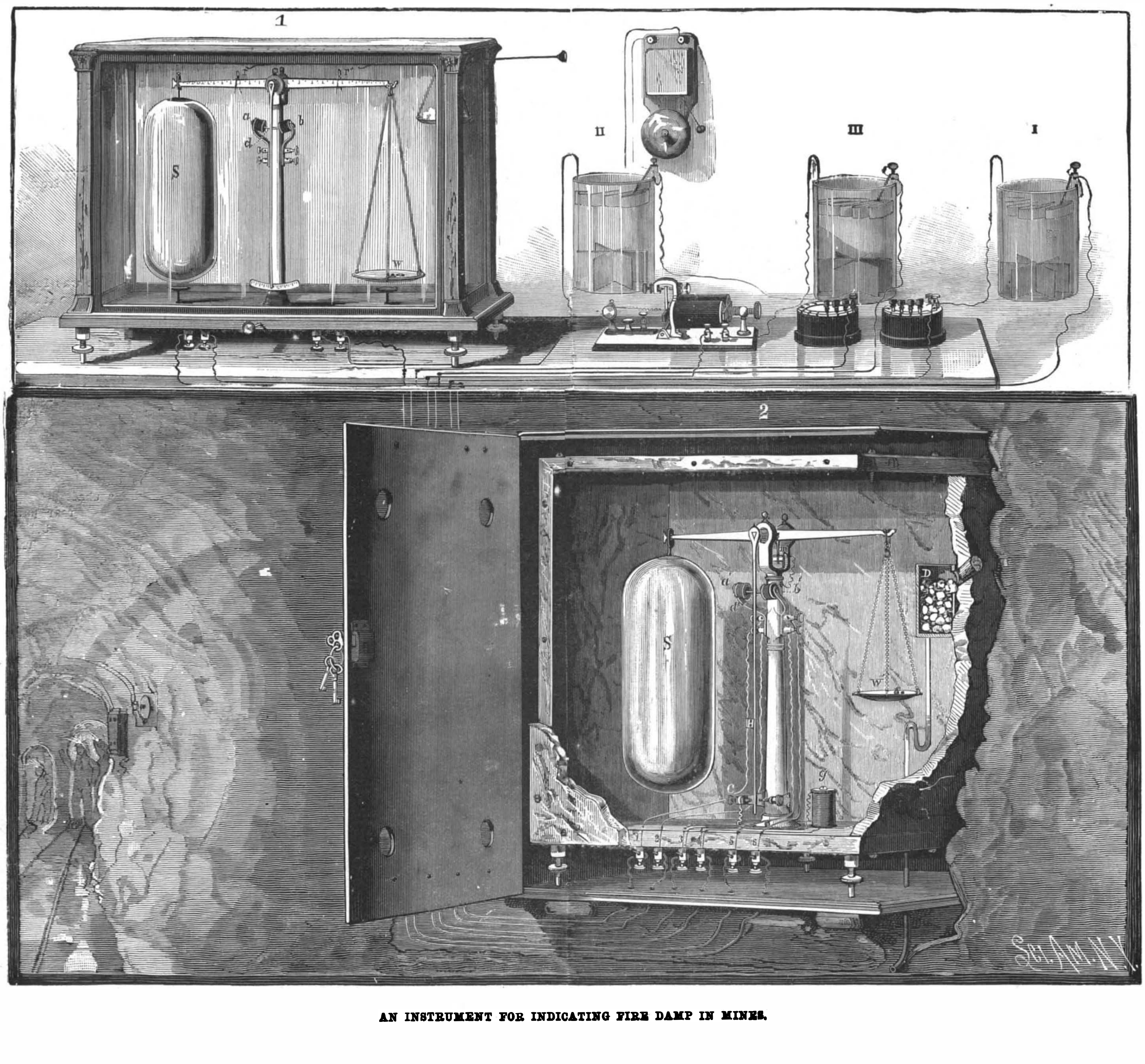
dipped. By contact between *H* and *c*, the relay in the observing room is kept closed. Breaking contact opens the relay, whose back stroke shunts the local circuit on the bell, ringing it continuously. The resistance coil, *g*, connected to binding posts 3 and 4, prevents a spark passing when *H* and *c* break. The case surrounding balance No. 2 is of marble or unglazed tiling excluding air currents and dust, yet admitting gases by diffusion. Chloride of calcium, in the holder, *D'*, keeps the interior free from moisture. The whole is protected from injury by a perforated iron case, as shown. Once placed in its position in the mine, its temperature will be constant.

Balance No. 1, in the observing room, is provided with two riders, moved along the graduated beam as shown. If more delicate readings are desired, additional riders of less weight may be also employed, a separate way being provided on the beam. Balance No. 1 is incased, dried by chloride of calcium, and placed in a room artificially maintained at constant temperature by means well known.

By this arrangement it will be seen:

1. That as the two bulbs, *S* and *S'*, are equal in bulk, and balanced at the same moment, they will be affected equally in weight by an increase or decrease in atmospheric pressure.
2. That the right-hand helix of each instrument will exert the same amount of force on its responsive needle, both being supplied with current from the same battery, and that the same rule will apply to the left-hand helices.
3. That as each instrument is kept in an atmosphere of constant temperature and equal hygrometric condition, it will only be sensitive to a change in the pressure of said atmosphere or a change in its atomic weight.

Both instruments are balanced at the same moment by their weights, *W* and *W'*, respectively. The case of balance No. 2 is then filled with pure fire damp at



AN INSTRUMENT FOR INDICATING FIRE DAMP IN MINES.

normal pressure, obtained from a "blower" in the mine. (This will obviate the necessity of correcting for that percentage of carbonic acid always associated with marsh gas in fire damp, as would be necessary if pure marsh gas were used.)

Care, of course, is taken to keep a stream of the gas flowing in, to counteract the diffusion of air through the case. Bulb, *S'*, will now sink, its increase in weight being about 39 grains, *H* will break contact with *c*, and the bell rings. The observer now switches on battery I., which applies a force of say 45 grains through helix, *a'*, to the needle attached to the vertical arm of balance No. 2. This more than compensates for the increase in weight, *H* is brought back to *c*, and the bell ceases to ring. The observer now throws in small resistances until *H* breaks again, and thus finally satisfies himself that the amount of force applied through helix, *a'*, of the distant instrument is just enough to balance it and no more. Now, as this amount of force is also exerted by helix, *a*, upon the needle of balance No. I, its equilibrium is disturbed. Rider, *r*, is therefore shifted until equilibrium is restored. The position of this rider equals the force applied through helix *a*, equals the force applied through the helix of the distant instrument, No. 2, and necessarily equals the increased weight of the bulb, *S'*, in pure fire damp. From this point, therefore, to zero, the observer graduates his beam into hundredths and minor subdivisions. The graduation is then made in similar manner for carbonic acid, employing rider, *r'*, and battery II. In practice, these graduations would be made before the instruments were placed in position, allowances being made for the depth and increased temperature to which each balance is to go.

Thus adjusted, the instrument will act under the conditions named as follows:

1. Rising Barometer and no "Fire Damp."—The pointer of the observer's instrument will be deflected to the left. On applying battery II, both balances will come to equilibrium with the same amount of electrical force, the distant instrument indicating by the bell, as described.

2. Falling Barometer and no "Fire Damp."—The bulbs in both instruments will sink when the atmospheric pressure is below the point at which they were adjusted. Equilibrium will be restored to both by force applied from battery I, as described.

3. Rising Barometer and "Fire Damp."—The observer will find, on applying current from battery II, that the distant instrument comes to equilibrium with a weaker current than his own. Keeping that in equilibrium by the current, he moves the rider, *r*, until his own balance is in poise. The position of this rider necessarily gives him the percentage of fire damp in the case of the distant instrument.

4. Falling Barometer and "Fire Damp."—Both balances are disturbed, but balance No. 1 is only affected by the change in barometric pressure, while balance No. 2 is affected both by that and by the fire damp. Hence, the power now applied by battery I, sufficient to balance the distant instrument, will overweight the observer's. The amount of this overweight is determined, as before, by rider *r*, and the percentage of fire damp is given.

The tests for carbonic acid are similar, rider *r'* being found necessary to restore equilibrium to the observer's instrument.

Applied to a general system, a number of balances like No. 2 would be placed in various portions of the mine, the left-hand helices all being on one circuit, and the right-hand helices on another, connected with the one balance to be used in the observing room. Separate wires would be run for the bells serving to indicate the movements of each instrument. The tests would then be simultaneous, full battery power being thrown on, and then gradually weakened by the rheostat; measurements being taken on the observer's balance as each bell gave warning that one or more of the distant balances were in equilibrium. These tests could be frequently made, and notification promptly signaled to the miners in any drift in which a dangerous percentage was observed, or to the fire boss and his assistants.

The percentage of carbonic acid exhaled from coal usually runs from 0.30 to 2.1 per cent in fire damp, varying in different mines, but practically constant in any one. There may be a sudden increase by an explosion, but ventilation would soon restore the normal condition. The quantity produced by the lamps and men is insignificant, since the ventilation necessary to keep the mine free from fire damp sweeps away the carbonic acid from this source as fast as formed.

Should it be desirable to test for marsh gas only, balance 2 may be surrounded by an air-tight case, provided with a tube opened or shut at will by a mercury valve operated by an electro-magnet controlled from the observing station. This tube would be opened for, say, five minutes. During that time the external gases would diffuse perfectly through the tube into the case, but both moisture and carbonic acid would immediately be absorbed by caustic potassa placed in *D'*. The tube would then be closed, and measurements taken, pure marsh gas being the standard. These tests would be made as often as desired, the observer having full control of the valves on all the instruments and operating all on one circuit.

While a separate circuit is shown for the right-hand or left-hand helices, it is practicable, by a simple device arranged by the inventor, to operate either helix at will from the observing station, and yet use but a single circuit.

With bulbs of 300 cubic inches capacity, a balance weighing to one-tenth of a grain will give the percentage of marsh gas to one-third of one per cent. The bulbs weigh six ounces. This weight may be lessened 86 grains by filling them with pure hydrogen. A reading to one-third of one per cent is close enough in practice.

The instrument is especially designed for use in goaves, where large accumulations of the gas are more liable to form. A decrease in atmospheric pressure forces it out in the workings, where it may be fired by a shot, a defective lamp, or other causes. It having been settled that the explosions supposed to be wholly due to coal dust depend on marsh gas in conjunction with the dust, the necessity for close watch upon even small percentages is obvious.

As marsh gas spreads with tolerable rapidity, one instrument will guard a considerable area, especially in a goaf where ventilation is neglected.

Aeronautical Notes.

According to recent reports, it appears that the Italian government is taking measures to construct an airship upon the plans of Major Morris of the Engineering Corps. Major Morris first applied to the War Department in order to have his plans carried out, but he was unable to secure the necessary appropriation for this purpose. However, he succeeded in interesting King Victor Emanuel in the matter and in this way was able to secure a credit of $80,000 in order to build the airship. Accordingly he set about constructing it, and it is said to be nearly completed at present, although the matter has been kept quite secret up to the present time. It is also stated that he made the first trial of the new airship upon Lake Bracciano, not far from Rome, and that the results were all that could be expected. In view of this, it is intended to use the airship in the next military maneuvers of the Italian army.

Santos Dumont has been occupied of late with his new aeroplane, No. 19, which we have already described. The new two-cylinder horizontal motor is now in very good shape, and the aeronaut is quite well satisfied with it. As to the propeller, however, he has decided to make some changes which he thought would be preferable, after some of the trials he already made, and the single screw of aluminium is now replaced by two propellers of smaller diameter. These latter are mounted in the front part of the framework, and are driven by belt from the motor. They run side by side, and in opposite directions. Built of a wooden frame covered with silk canvas, the new propellers were constructed after M. Tatin's design. As to the motor, it will be remembered that it is air-cooled, and there is therefore no water tank mounted on the flyer. The gasoline tank, which contains about 2 liters (one-half gallon), has now been placed at a higher level in order to secure the best pressure on the carbureter. The unfavorable weather which has prevailed of late has prevented trials from being made, but it is expected to begin the preliminary flights as soon as the weather will permit.

Belgium's Proposed Military Dirigible.—It is proposed to construct a new military airship in Belgium, should Parliament vote the $20,000 which will be needed in order to carry out the present plans. The design of the airship is due to Commandant De Saint-Marcq, of the Aerostatic Corps of the Army Engineering section. He is now engaged in finishing the plans, which embody some original features, and he claims to have found a new combination which will make it possible to drive the airship at high speed or to allow it to remain in the air for a long time when traveling at low speed. Another arrangement is intended to overcome the disadvantages of the critical speed such as were pointed out by Col. Renard. He will endeavor to suppress the pitching of the balloon and to increase the security of the aeronauts. An improvement is also noted in the propellers, and the inventor claims to have a theoretical output which is 84 per cent higher than what is obtained at present. The interior ballonet is dispensed with, and should the balloon become torn, it will be able to descend as a parachute. The new balloon is to have gas-tight compartments, but will not have a metallic framework in the interior. Owing to the design of the compartments, the balloon is automatically transformed into a parachute in case of accident.

The principal dimensions of the new airship are as follows: Total length of envelope, 60 meters (196.8 feet); diameter, 10.6 meters (34.76 feet); circumference at point of greatest diameter, 33.284 meters (109.17 feet); surface, 1,900 square meters (20,364 square feet); total capacity, 3,750 cubic meters (132,331 cubic feet); corresponding lift, 4,125 kilogrammes (9,075 pounds); speed in still air with two propellers operating, 50 to 55 kilometers (31 to 34 miles) per hour; speed with one propeller only, 35 to 40 kilometers (21¾ to 24¾ miles) per hour; horsepower at 900 R. P. M., 120; diameter of propellers, 7 meters (22.96 feet); number of revolutions of the propellers, 225; speed at their periphery per second, 80 meters (264.4 feet); length of the keel, 33 meters (108.24 feet); length of the body framework, 1½ meters (4.92 feet); capacity of blower for ballonets, 3,500 cubic meters (123,000 cubic feet) per hour; motor operating blower, 6 horse-power.

The weights of the different parts of the airship are as follows: Balloon envelope of rubber-coated cloth, 700 kilogrammes (1,540 pounds); ballonet, valves, prow in a vertical plane, suspension and rigging, rudder, etc., 540 kilogrammes (1,188 pounds); nacelle or body framework, 350 kilogrammes (770 pounds); 2 motors, 480 kilogrammes (1,056 pounds); 2 propellers, 150 kilogrammes (330 pounds); flywheels, shafts, radiator, gears, movements, supports, bearings, tanks, oil, water, gasoline, piping, 245 kilogrammes (539 pounds); other accessories, 135 kilogrammes (297 pounds); gasoline for a 10-hour trip, 360 kilogrammes (792 pounds, or 132 gallons); water, 30 kilogrammes (66 pounds); 5 persons, 400 kilogrammes (880 pounds); ballast, 45 kilogrammes (99 pounds); total, 4,125 kilogrammes (9,075 pounds).

Engineer Louis Godard prefers to employ two motors of 60 horse-power each, driving separate propellers which turn in opposite directions. In case of breakage of one propeller or motor, the airship, driven by the other power plant, can still make 20 to 24 miles an hour, which will enable it to return to its starting point instead of drifting at the mercy of the wind. The propellers used on this airship are the largest that have ever been tried on a vessel of this character. They are a trifle larger in diameter even than those employed by Maxim upon his large aeroplane with which he experimented in England over a decade ago.

M. Louis Bleriot made an official entry at the Aero Club in order to try for one of the 150-meter prizes which had been established by the Aviation Commission. He made two trial flights, one of which brought him within 5 meters of the finish, but at the same time he came very near having a serious accident. As it was, his aeroplane suffered much damage from a fall which it had. In the presence of the official timekeepers and others, among which were Santos Dumont, E. Archdeacon, Victor Tatin, and other well-known aeronauts, he succeeded very well in the first two flights, and it was thought that he had covered the distance. But upon measuring this, it was found that he lacked reaching the finish by the above amount. At 3 o'clock he started out for a new flight, and sailed along in good shape at a height of about ten feet, but coming down to the ground, the carrying wheel on the left side gave way under the shock and this made the left wing of the flyer to dip over and scrape along the ground. The rear part struck the ground violently and was much damaged by the accident, burying the pilot, and it was feared that he might be injured. Fortunately he escaped with a few bruises, although it took some time to free him from the wreck. The aeroplane is quite broken in many parts, the helice is twisted and a shaft broken, while the framework is distorted and the rear part much broken up. As to the wings, they are in better shape and suffered the least from the accident. The Antoinette motor did not receive any damage. M. Bleriot will at once set about repairing his flyer, and it is thought that he will be in shape to continue his flights within two weeks.

Cheaper Radium.

Three grammes of radium (about forty-six grains), the largest quantity yet produced at one time, has been extracted by the Imperial Academy of Sciences of Vienna, from ten tons of uranium and pitchblende given them by the government from its mines in Bohemia, and although the crude material cost nothing, the extraction alone amounted to $10,000. This, however, cheapens the cost of radium considerably, for the three grammes, approximately, above mentioned, were obtained at one-third the cost of previous products which, it has been estimated, would be worth not less than $3,000,000 an ounce. A small fraction of the yield has been presented to Sir William Ramsay, the English scientist, for experimental purposes. A part will be used by other researchers to test Prof. Ramsay's theory regarding the breaking up of radium into other elements.

Denatured alcohol to the amount of 1,744,272 gallons was produced in the United States during the first six months of 1907. The free alcohol law took effect on January 1, 1907.

Correspondence.

The Moth-Proofing of Woolens.

To the Editor of the SCIENTIFIC AMERICAN:

Holland, in his recent book on "Moths," says that the depredations of the clothes-moth annually cost citizens of the United States enough to pay the interest on the national debt.

As is well known, this destructive immigrant from the old world multiplies rapidly, laying its eggs in furs or woolens. If undisturbed, wormlike larvæ hatch from the eggs and subsist upon the wool until they attain the form of the adult moth. Costly tapestry and humble flannels are alike riddled by them, whether the fabric be wholly or only partially of the hairs of animals.

When living at Swatow, China, my house there was infested with clothes-moths; and in experimenting with various substances with a view to ridding my dwelling of these and other insect pests, I found alum to be preventive of the ravages of the clothes-moth. I gave the efficiency of alum a severe test by making picture cords wholly of woven yarn, immersing these cords, to the number of a score or more, for some hours in a saturated solution of alum, and then using the cords for suspending rather heavy pictures. The cords thus treated showed no sign of weakness during the ensuing three years or more.

A basketful of worsteds that I had used in testing the Chinese for color-blindness, by Seebeck and Holmgren's method, was likewise treated with alum, and was afterward left standing open and undisturbed for over two years without its being the least moth-eaten. The tints of the worsteds were not altered by the alum-water, although some of the skeins were of delicate shades of blue and pink as well as of red, green, and brown. For soaking these worsteds I was, of course, careful to use clean solutions, keeping each color apart from all others during the submergence.

Shawls and other fabrics, likewise soaked in alum-water, remained intact for several years, with only the alum as a defense against moths.

The alum does not evaporate, and is therefore a permanent protection to unwashed fabrics. One pound of alum to four quarts of water generally made a sufficiently strong solution. Crude alum is not expensive. If the alum were used by the dyer to treat the dyed yarn, thus making the fabric woven from it moth-proof, these fabrics would have a higher commercial value; the labors of clothiers, merchants, and housekeepers would be greatly lessened, and homes might display beautiful rugs, carpets, and curtains all the year through. ADELE M. FIELDE.

Seattle, Wash., November 24, 1907.

Japanese Marksmanship.

To the Editor of the SCIENTIFIC AMERICAN:

The recent war scare between Japan and this country, has vividly recalled an episode of the Russo-Japanese war, which no doubt would interest the readers of the SCIENTIFIC AMERICAN, as it plainly shows the cleverness of the Japanese, and also gave those fortunate enough to witness it a very poor opinion of their much-vaunted marksmanship.

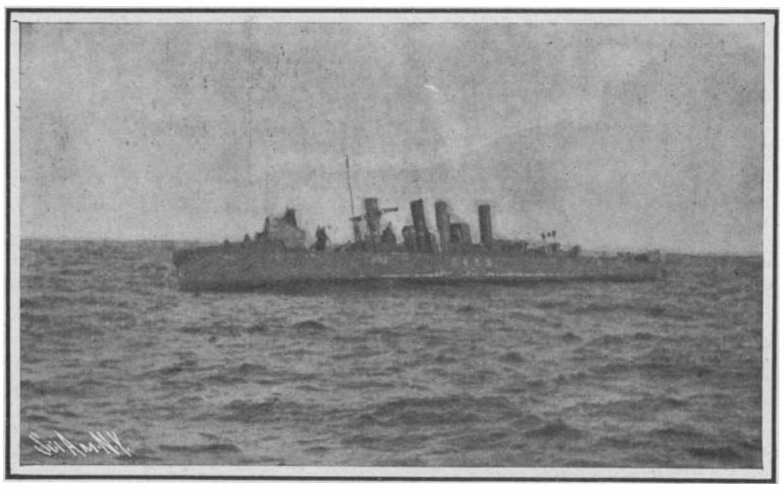
On September 20, 1904, the U. S. gunboat "Villalobos," on which I was serving as electrician, left Peitaho, in the Gulf of Pechili, early in the morning for Chefoo.

We took a course which brought us at 5 P. M. to within eleven miles of Port Arthur, when we sighted a floating mine and stopped to fire at it.

Three or four rounds were fired from the 6-pounder on the quarter-deck, when we noticed a torpedo boat coming toward us from the east, and steaming about 18 knots. It proved to be Japanese T. B. 66. They nearly ran down the mine in spite of our signals to them. When they noticed it they sheered off, and after placing themselves so that we formed a triangle with the two boats and the mine at the extremities, commenced firing with their forward 1-pounder. The exhibition they gave would have been laughable under other circumstances, but we were too close to find much humor in it. Their shots were all high, and many varied at least 15 deg. on either side. Then seven or eight seamen commenced firing with rifles.

After watching them for a few minutes and steaming into safer water, we fired two rounds with our port 1-pounder, the second breaking off a plunger and sinking the mine. We were close enough at one time for me to take the photograph, showing two dummy smokestacks of canvas placed over frames. These were probably used when other boats were being repaired in Japanese navy yards by running in sight of Port Arthur with the two steaming stacks, the first and third in the photograph. Then after running out of sight, returning with first one and then both of the dummy stacks in position, giving the Russians the impression of being blockaded by a larger fleet than was actually the case. S. M. HENDERSON.

246 Elm Street, Albany, N. Y.



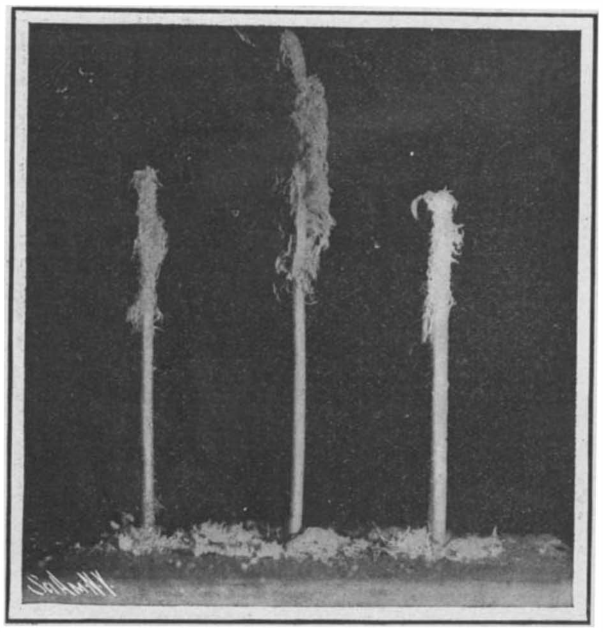
PHOTOGRAPH OF A JAPANESE TORPEDO BOAT, SHOWING DUMMY SMOKESTACKS.

Experiments with Aluminium.

To the Editor of the SCIENTIFIC AMERICAN:

While experimenting with aluminium as a negative element in batteries, the following phenomena were observed, which may be interesting to some of your readers:

Aluminium may be dissolved in a caustic soda solution according to the following well-known reaction:



GROWTH IN TEN MINUTES ON AMALGAMATED ALUMINIUM RODS.

$$6NaOH + 2Al = Na_6Al_2O_6 + 6H.$$

If fresh aluminium and water be added to the above product, the action will continue with the production of hydrogen and considerable heat, the sodium aluminate seeming to act as a catalytic agent, probably in the following reaction:

$$2Al + 6H_2O = Al_2(OH)_6 + 6H.$$

While ordinary aluminium is very rapidly dissolved by caustic soda solution, if it be amalgamated by thorough cleaning with hydrochloric acid or a dilute solution of caustic soda and rubbed well with mercury, it will not be dissolved unless placed in electric connection with a more electro-positive element. In this way aluminium may be used to replace zinc in batteries whose electrolyte is alkaline. There seems to be no advantage in aluminium over zinc in acid or neutral solutions, though with alkaline solutions the e. m. f. with aluminium couples is greater than with corresponding zinc couples.

While ordinary aluminium is not changed when placed in water, a rod of amalgamated aluminium will slowly give off hydrogen when placed in water.

An amalgamated aluminium rod in the open air will be almost immediately covered with a grayish white coating of a hydrate. This will gradually grow and flake off for a considerable time. If a rod of drawn aluminium wire be amalgamated about one-fourth its length and fastened by its base vertically, amalgamated part on top, this growth with the rod will resemble somewhat a palm tree in shape, as the growth will radiate from the rod in strata which seem to be governed by the "grain" of the rod by drawing.

Montgomery, Ala. A. M. KENNEDY.

The Sling for Throwing Hand Grenades.

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest the article entitled "The Hand Grenade in Our Army," as given in the latest edition of the SCIENTIFIC AMERICAN, and in view of the possibility of the hand grenade being adopted, offer the suggestion that, if it is put into use, it would be desirable to supply soldiers, using the grenades, with slings, thereby considerably increasing the distance to which the grenade could be thrown, without the use of any form of mortar.

No doubt, with a little practice, our soldiers could acquire considerable accuracy of aim in using the sling in conjunction with the grenade; also the sling is so light and simple that it would add practically no bulk or weight to the present equipment.

AMÉDÉE V. REYBURN, JR.

St. Louis, Mo., December 23, 1907.

Use of Gas from a Hygienic Standpoint.

To the Editor of the SCIENTIFIC AMERICAN:

There appeared lately in the SCIENTIFIC AMERICAN SUPPLEMENT an address by Prof. Lewes entitled "Use of Gas from a Hygienic Standpoint," in the first installment of which the author discusses gas versus electric illumination from the health point of view.

The article is cleverly written, and presents a number of important facts, without however giving the necessary data to support his conclusions. This may be due to the wish of the author to draw the fire of his critics, or again it may be merely a report of the hasty experimenting of an enthusiast. As it stands, it appears that the following criticism applies.

The author repeatedly refers to a hall which he has "in mind," and then proceeds to state his opinion of the relative amounts of carbon dioxide when lighted by gas and by electricity. He gives no measurements in either case; and while he emphasizes the importance of ventilation, he neglects to state the method and the measure of ventilation of the said hall. My personal opinion is that when a hall is comfortably filled with people, the amount of carbon dioxide thrown off by the gas burners is very much less than that thrown off by its human occupants, and therefore the important question is not the illuminant but the ventilation, as would also be the case in a moderate-sized living room were it as proportionately filled with persons as the hall.

To illustrate the point, the common rule in America is that one gas burner throws off as much carbon dioxide as five persons. Two of them, enough to illuminate an ordinary room, will throw off as much carbon dioxide as ten persons. Such a room, however, crowded to the same extent as the hall, would hold from thirty to fifty persons, who would contribute from three to five times as much carbon dioxide as the burners.

To return to Prof. Lewes's paper; the data which he gives for the gas and electrically lighted rooms are worthless unless he states the degrees of ventilation in both cases. He does not even state whether the rooms were occupied or not, nor how many persons were in them, nor how long they remained. Again, he does not state how long the two Welsbach burners were burning, nor how long the electric lights were burning. You will appreciate that the condition of the air is a progressive one, affected by all the things that I have mentioned, and which the author fails to definitely set forth.

His statement as to the destruction of germs and organic material by gas flame has more rhetorical strength than fact to support it. Can you conceive that the gaseous envelope of a mantle or fish-tail flame—and it is only at the approximate surface of the flame that such destruction can take place—can you conceive that this small surface can in any measure at all destroy the organic impurities?

Neither can the trace of sulphur dioxide contribute materially to the destruction of the noxious portions of the air. You will note also that the author was very careful to avoid any statement as to the poisonous effect of sulphur dioxide itself, even in small quantities. He neglects also to discuss the hygienic effect of carbon monoxide which is found in improperly regulated Welsbach mantles, and is a toxic poison. J. H. SMITH.

New York, December 12, 1907.

Interesting fossil finds have been made in the San Gabriel Valley, California, by laborers working on an outfall sewer for the city of Los Angeles. At a depth of about 100 feet under the Inglewood hills, which lie between the city and the ocean, they came upon two large skeletons. These they supposed to be giant saurians, but some of the bones were sent to the Smithsonian Institution, who report that one is a skeleton of *Elephas columbi*, while the other was that of a mastodon—possibly of a new species. Other bones have been found and there is hope that some perfect skeletons may be obtained. In another part of the excavations the workers have come across flints and other traces of early man.

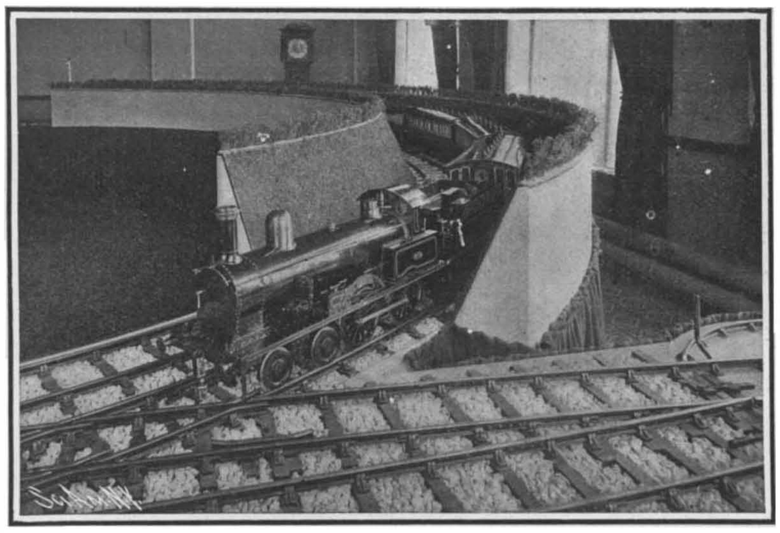
A RAILROAD IN MINIATURE—A TOY LINE WHICH COST $50,000.

BY W. G. FITZ-GERALD.

It is surprising to find how many engineers and rich men amuse themselves with toy railroads. Apart from miniature systems that actually carry passengers (usually children) and freight of the mildest, the palm for the most elaborate and costly railway ever constructed must be awarded to England.

Its owner is Mr. Percy H. Leigh, of Worsley, one of the suburbs of Manchester. "Some men spend their money on race horses, others on yachts, and so on," Mr. Leigh remarked; "but this railroad of mine distracts me more than any of these things." Since nothing short of absolute perfection in every detail was aimed at, it is not surprising that, from first to last, well over $50,000 has been spent upon this costly hobby. Instructions were issued to the contractors who built and equipped the "road" that there were to be no dummies, and every device and fitting was to be carried out accurately to scale.

The "country" through which the railway runs is a huge single-storied building of one room, 90 feet long and 30 feet wide. It has been added to Mr. Leigh's residence, and was specially constructed so as to give the line sufficient range for successful operation, and also to afford protection from damp and bad weather.

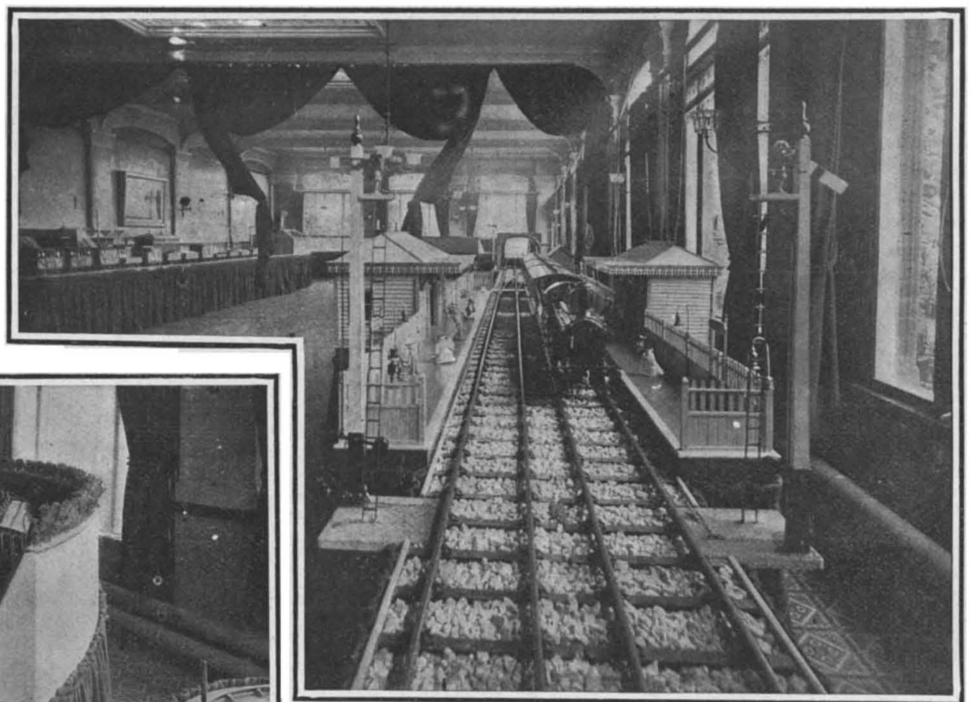


The Train Emerging From the 40-Foot Cutting.

The room has a double floor—first the wooden one on which stand trestles supporting the track, and then two or three feet below comes a foundation floor of concrete. An even temperature all the year round is secured by means of hot-water pipes. The system is known as the "Oakgreen and Beechvale Railroad." The road-bed is of pitch pine, mounted on sixty-five trestles some 3 feet from the floor; and the track extends to 276 feet of a double line of rails.

There are 1,200 feet of rails in all and they were specially rolled for Mr. Leigh in Sheffield. These rails are all of mild steel, double-headed, about an inch high, and some of them nearly 12 feet long. They are fastened down to 2,000 pitch pine sleepers by means of 4,000 malleable cast-iron chairs—rails are not spiked down in England—held in place with hardwood wedges, and 16,000 screws. All the fishplates, bolts, and nuts used in joining the rails together are exact miniature reproductions of those seen on the London & North Western Railroad, which is the standard system of the United Kingdom.

The track is ballasted with about half a ton of limestone chips, and the gage is 6 inches. The line starts from Oakgreen, the principal station, where are located the "offices of the management." In front of the building is a platform 24 feet long, with the usual seats and other conveniences for passengers. This platform is sheltered by a glass roof, while the gates admitting to it are of the regular palisade type. At the very end is a passenger footbridge of trellis work, covered over; this stands high above the line and is reached by two staircases. One notices warnings to the "passengers" not to cross the track by any other means; at the same time there are level crossings for the greatly daring. Behind the station proper is the freight depot and sidings, some 40 feet long. Some of the freight sheds are 4 or 5 feet long. The stations, and indeed the whole system, are beautifully lighted with electric lamps fitted with reflectors. In all there are 58 of these soft, restful lights, and a specially tall one is established in the freight depot in order to carry on work. These lamps are supplied from storage batteries placed under the track, and their capacity is enough to light up the whole room without bringing the gas into requisition. Electric lamps also light the signal cabins and posts along the line.



The Train Pulling Into Beechvale Station.

In one signal box are no less than 26 levers, from which stretch flexible wires to the signal posts. Of these last there are a round dozen, 3 to 4 feet high, and fully equipped with semaphores and lamps showing red, green, and white. Besides these the signal cabins also work sixteen sets of points by means of rod connections and levers. Every detail in the matter of signaling and shunting has been thought out and executed with amazing accuracy, so as to heighten the effect of reality which is the chief impression given by this extraordinary toy system. Two turn-tables are provided to take locomotives and tenders. These tables have four levers for the points, and are likewise fitted with spring buffers. As the train passes on its way it takes a long cutting of some 40 feet, and 2 feet in depth; the sides of this cutting are covered with grass, and on top of both sides a dwarf hedge is planted by way of scenic attraction.

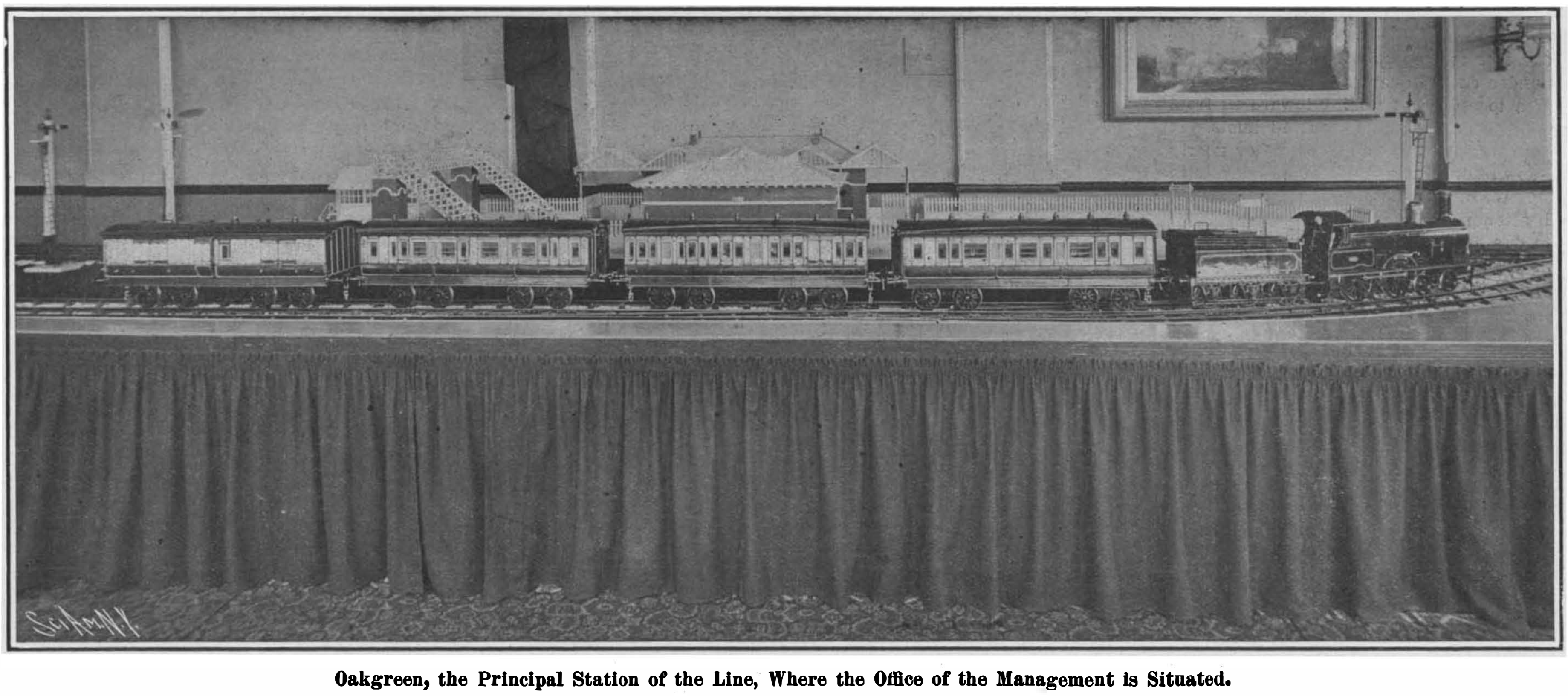
Beyond the cutting the railroad is crossed by a bridge; and before reaching the second station, Beechvale, a long and somewhat dreadful-looking tunnel has to be negotiated; its actual length is 18 feet. The locomotive with its tender is 5 feet long and 18 inches high. It is a 6-inch-gage exact duplicate of an express engine of the London & North Western Railroad. The only points in which it differs from its prototype are, first, a smaller number of tubes in the boiler; second, the model has no injector; and third, steam is gotten up by a charcoal fire kept at great heat by a special blast. Engine and tender cost $1,800 and took nearly nine months to complete. Altogether this marvelous little system took upward of two years to build, of which period one-fourth was occupied in fitting up the huge room in which the train runs.

The speed of the engine on the straight is about six miles an hour, and of course considerably less on the curves at either end. These are 26 feet in diameter. Some difficulty was experienced by the contractors in getting these curves exactly right, as the 6-inch gage of the railroad introduced an entirely new problem in construction. The powerful little engine can travel six times round the entire length of the system without a renewal of its charcoal fire.

Needless to say, there are both passenger and freight trains. The former consists of four cars; and the usual first, second, and third class of European railroads are carried out with a regard for detail in upholstering that is almost amusing. Hat racks, window blinds, mirrors, lavatories, carpets, and so on, are all forthcoming; but the third-class is appropriately austere, with bare polished wood.

The luxurious passenger cars are mounted on bogies and are completely equipped with carriage springs, grease boxes for the axles, spring buffers, draw bars, and screw couplings.

The freight train of this little system is equally remarkable in its way, being composed of ten cars and

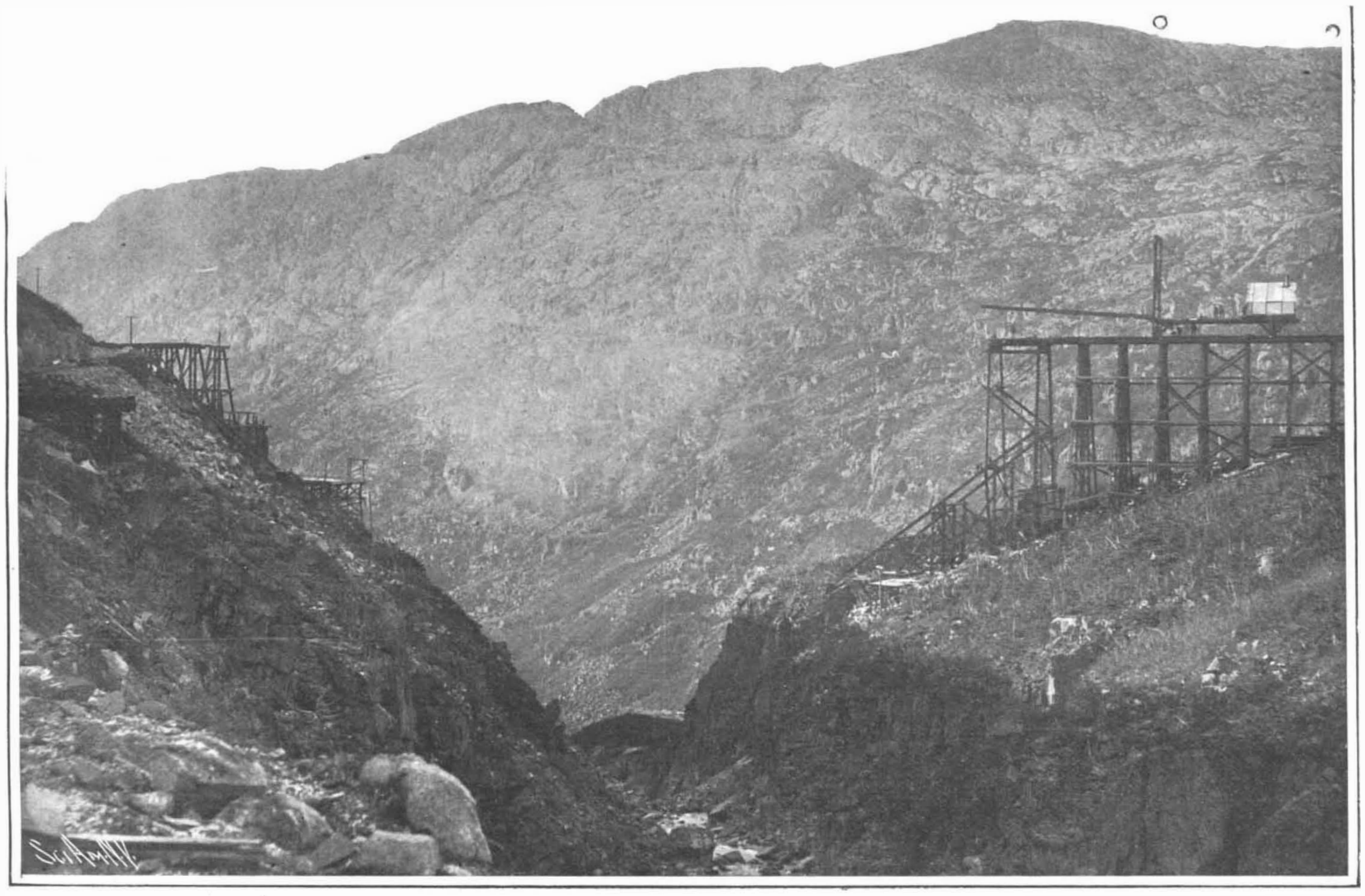


Oakgreen, the Principal Station of the Line, Where the Office of the Management is Situated.

A RAILROAD IN MINIATURE—A TOY LINE WHICH COST $50,000.

a guard's brake-van, fitted with a screw-down brake of the usual English kind. Accommodation is provided for every kind of merchandise from coal to cattle; and in the freight depot will be found appropriate loads consisting of logs of wood, masses of slate and marble, casks of beer, and so on. All the freight cars are fitted with hand lever brakes, tarpaulins, chains, hooks, stanchions, and everything necessary for handling the freight traffic of the railroad.

Each car was modeled with scrupulous accuracy from the London & North Western system, which took a friendly interest in its toy neighbor, and lent drawings and models for copying. Needless to say, people flock from far and near to see Mr. P. H. Leigh's wonderful miniature railroad in operation, and it has already realized many thousands of dollars for charitable purposes.



The Steel Cantilever Bridge Spanning the Canyon, in Process of Construction.

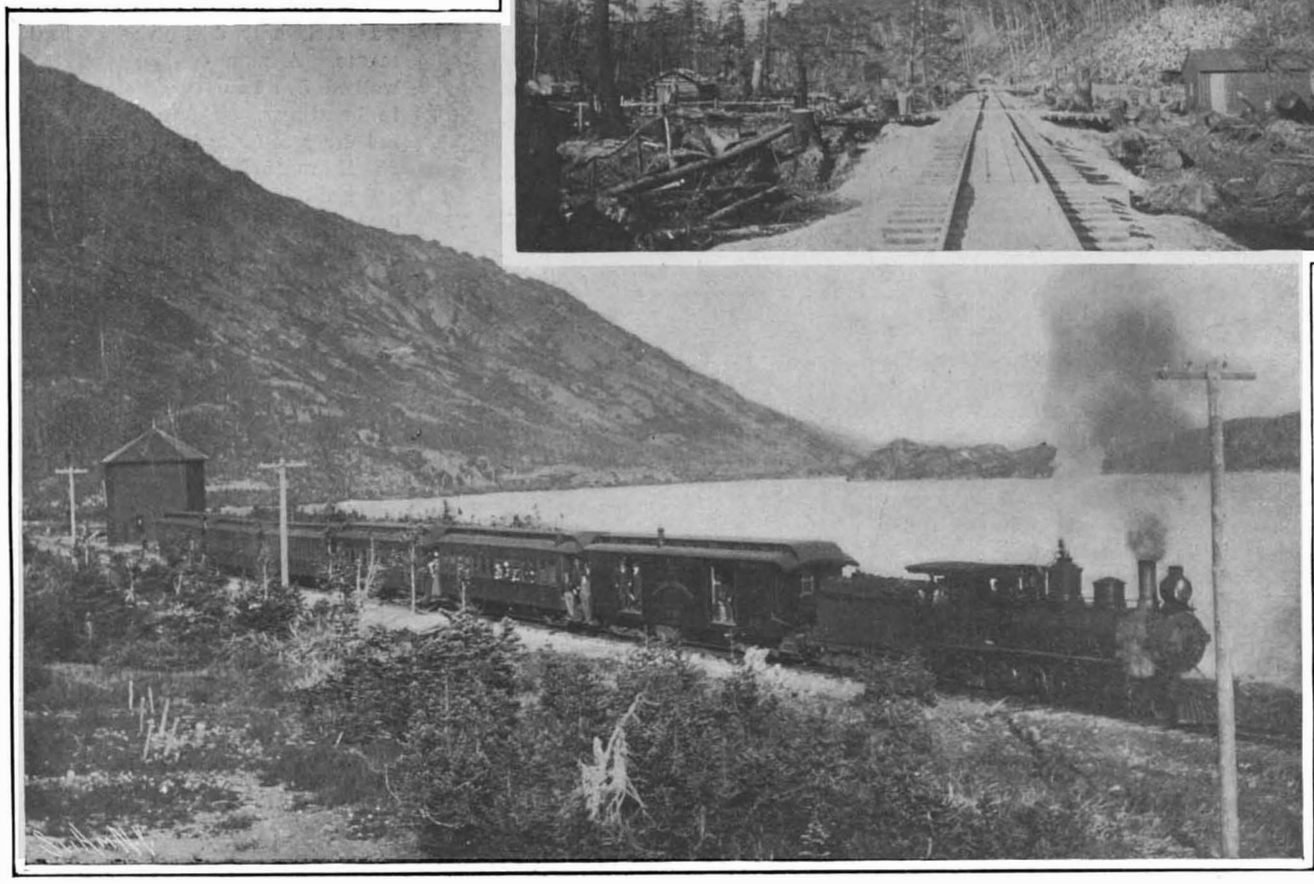
THE MOST WONDERFUL RAILROAD OF THE NORTH.

BY KATHERINE LOUISE SMITH.

Alaska is the greatest scenic country in the world, an empire of the North where nature has been lavish in a combination of sea and mountain views that are colossal and sublime. The fjords of Norway, the austerity of the Russian steppes, the grandeur of the Rhine and the Alps, are all combined here to make scenic beauties that almost surpass the imagination of man. Rugged, wild, and undeveloped as the greater part of this vast territory is, it nevertheless possesses an extraordinary piece of engineering work, rivaled in but few other countries, no matter how far advanced in civilization. This is one of the most remarkable railroads in the world, running from Skagway inland, connecting the seacoast with the interior. By means of this railroad, the White Pass and Yukon, the traveler can to-day traverse in a few hours a stretch of country that ten years ago was almost impassable. The White Pass and Yukon Railroad is a revelation, a fitting climax to the thousand miles of inland sea that stretches from Seattle to Skagway, Nature's art gallery seems unfolded in the panorama of mountains, glaciers, gorges, cascades, valleys, and streams that can be seen from a car window on this road.

The engineering work in the construction of the road was among the most daring of modern times. It is built on mountain sides so steep in portions that men had to be suspended by ropes to prevent their falling while cutting grades. The first 20 miles out of Skaguay cost $2,000,000, and the average cost of the road from Skagway to Summit was something over $100,000 per mile. From there to its end the expense was greatly in excess of what a similarly constructed road would have cost in the United States. The building of this road over the once-dreaded White Pass to White Horse, where it meets river and lake steamers for Dawson and Atlin, has robbed the journey into the interior of many of its former terrors, and has made it possible to visit this famous gold region without difficulty. Though several trails were formerly used to reach the inland gold fields of the Yukon from the coast, the most famous were the Chilkat and the White Pass, the former known as the Dyea and the latter as the Skagway. The latter trail became popular in 1897. It was constructed by a British corporation, ostensibly to secure a charter from the Canadian government, and it began with a wagon trail starting from Skagway Bay, an inlet of Lynn Canal. That summer the trail was extensively used, as the rush to the gold fields had commenced. Immediately Skagway, a town of tents and shacks, grew into a young city of far more substantial construction, and in a very short time was thriving with almost every branch of industry. Work on the railroad was commenced in 1898 by Mr. E. C. Hawkins, the chief engineer. When he arrived at Skagway with his crew of men, he found the maps and reports of this perilous region, which had been furnished him, were so inaccurate as to be worthless. New surveys were immediately undertaken, and after five different expeditions, horses and railroad material were landed and the work commenced. Two months later the first train was run for five miles out of Skagway, an historical event, as it was the first railroad to carry passengers in Alaska, or at any point as far north as this on the American continent. After tremendous difficulties, the track was laid as far as Summit, and amid great enthusiasm the first train arrived at White Horse. The progress of the road was watched with the greatest interest, not only by the miners of Alaska, to whom it meant so much, but as well by the technical world at large; for while every mountain road is difficult to build, this one was attended by more than the usual difficulties. Aside from almost impassable stretches of country which had to be traversed, the scene of operation was a thousand miles from the base of supplies, as everything was, perforce, shipped from Seattle and Vancouver. In one place, a cliff 120 feet high, 70

The Valley About Three Miles from Skagway.



Middle Lake, B. C., on the White Pass and Yukon Railway, Showing a Crowded Excursion Train.

THE MOST WONDERFUL RAILROAD OF THE NORTH.

feet deep, and 20 feet thick, had to be blasted away in order to get space for the roadbed. Notwithstanding that the road spans mountains 6,000 to 7,000 feet high, there is but one tunnel on its entire length.

Eighty-one miles from Skagway, the road runs through the bed of a lake. During the building, difficulty was experienced in securing a feasible line along the shore of this lake. Therefore, it was proposed to lower the water level of the lake about 14 feet by excavating an outlet channel. After this was completed, the water soon cut its way into the sandy hill through which the outlet had been excavated, and in the end the lake level was reduced over 70 feet. This made it necessary to construct two large bridges over the great canyon formed by the outlet in the hill. To-day the road runs directly through the former bed of the lake.

Altogether, about 35,000 men were employed in constructing the road, and strange to say, but thirty-five died from sickness and accident, an extremely small proportion under the circumstances. The workmen were fortunately of an extremely intelligent class of men. Many were prospectors, anxious to reach the gold fields, but glad to work during the winter while waiting for the opening of navigation. Others again labored to replenish their exhausted capital in order to start out on further prospecting trips. This feature of the construction was not, however, without its attending disadvantage. For instance, in one day 1,500 men without warning drew their pay, abandoned the work, and started pell-mell for the Atlin country in the northern part of British Columbia, on the rumored discovery of new gold fields.

Recently, the original construction has been improved in many places. Switchbacks, trestles, and bridges have been replaced by more modern steel constructions, fills, and cantilever bridges. The road is operated daily, except Sundays, throughout the year. During the winter a rotary snowplow keeps the track clear, and it is seldom that snow delays the trains for more than a few hours. Furthermore, the track is constantly patroled to insure that bowlders falling from the precipitous mountain side, rising on one or the other side of the roadbed, may not cause a wreck. In winter the trains connect with an excellent stage service to Dawson, which replaces the boat service of the warmer season.

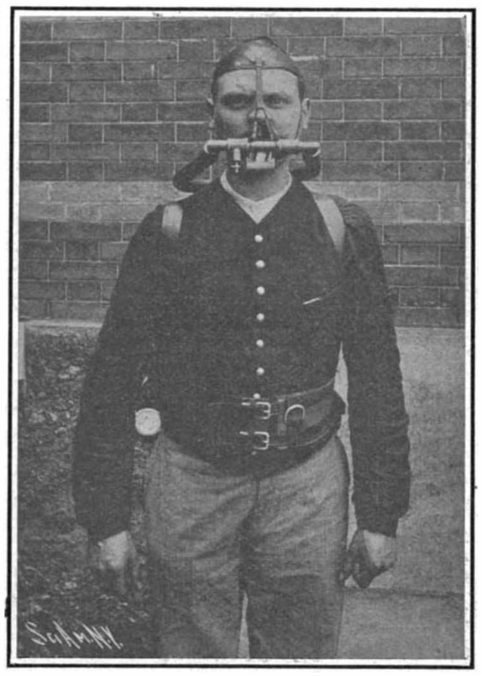
Three other Alaskan railroads, though in themselves of no great size, deserve notice because they are pioneering efforts of this character in a country that is practically a wilderness. They are the Alaskan Central, which runs inward from Seward on Resurrection Bay; the Council-Solomon road, from the mouth of the Solomon River on the shore of Behring Sea inland to the placer fields; and a unique little stub line called the Wild Goose, which runs from Nome to Dexter Creek.

The journey from Skaguay to the terminus of the White Pass and Yukon Road keeps the traveler in a perpetual state of wonder. After twice crossing the Skagway River, which runs in a narrow valley between high mountains, the train begins the ascent of the frowning fastnesses. The track follows the east bank of the river, until at the end of the seventh mile it reaches Rocky Point, a place so precipitous that the track is laid upon a bed blasted out of an almost perpendicular wall of solid rock. From this point of vantage is obtained a magnificent view of Skagway and the Lynn Canal, which is lost after passing the hanging rocks at Clifton, and the Pitchfork Falls. The latter is a waterfall 1,500 feet in height, which received its name from passing miners, because two-thirds of the way down it divides into three streams. At this point, hundreds of feet below the car, one can look down and see the old White Pass trail in the canyon, over which the intrepid prospectors toiled to reach the diggings.

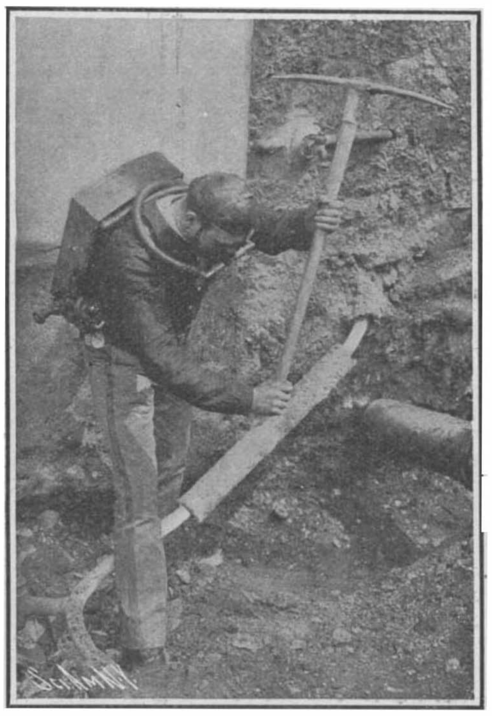
Across the canyon loom up the serrated peaks of the Sawtooth Mountains, and as the road winds high above the river, a glimpse of White Pass City is seen a thousand feet below, in the days of the old trail a town of a thousand inhabitants, but now comprising merely a few log cabins. Winding continually on its sinuous way around the mountains, making horseshoe curves, passing great glaciers, and always ascending, the train traverses a tunnel to that part of the road where the workmen were suspended during its construction. Here it halts for a last glimpse of the salt water, which sparkles in the distance many thousand feet below. Over the cantilever bridge, 215 feet above the bottom of the canyon, the engine puffs slowly, and soon the summit of this famous pass is reached, some 3,000 feet above sea level.

At the summit is located the international boundary, and here the Stars and Stripes float side by side with the Union Jack. This was formerly a Canadian mounted police station; but is to-day simply a railroad lunchroom. Nearby is Summit Lake, the waters of which flow both toward the north and the south—by way of the Yukon to Behring Sea, and through the Skagway River to the Pacific. A few hours further on the station of Bennett is reached, named after James Gordon Bennett by Lieut. Schwatka. This was the end of the White Pass trail, and it was here that formerly the prospector loaded his pack on a boat and paddled down Lake Bennett for the Yukon. To-day the railroad skirts this mountain-locked lake, and crosses the most northerly swing-bridge on the American continent, subsequently reaching Caribou station.

Down below are glimpses of the famous White Horse Rapids, rushing through the lava walls of the canyon at the rate of 15 miles an hour. By afternoon the little city of White Horse is reached, a thriving village full of bustle caused by the arrival and departure of trains and boats. From here it is possible to take the river steamer to Dawson, a trip of 400 miles, and another journey of scenic grandeur.



TISSOT'S RESPIRATORY APPARATUS. FRONT VIEW SHOWING FREEDOM OF CHEST AND ARMS.



AN EXCAVATOR EQUIPPED WITH TISSOT'S APPARATUS.

TISSOT'S RESPIRATORY APPARATUS.

BY JACQUES BOYER.

The various forms of apparatus hitherto devised for the purpose of making human existence possible in an irrespirable atmosphere have serious defects, which Dr. Tissot has succeeded in eliminating from the apparatus which he recently submitted to the Academy of Sciences of Paris. After making many physiological experiments Dr. Tissot has proved that a respiratory apparatus, in order to be of certain utility and maximum efficiency, must have a very great capacity—sufficient to allow normal labor to be performed for two or three hours and to enable a life-saver to remain in a poisonous atmosphere four or five hours, if necessary. None of the devices which are now most widely used —Draeger's air regenerator, Vanginot's compressed-air apparatus, the apparatus of Giersberg and Mayer employed in German mines—enable life to be maintained longer than one hour, or active work to be performed for more than 20 minutes in an irrespirable atmosphere. So that Prof. Nivoit, the director of the Paris School of Mines, has felt moved to make the apologetic comment that it would be only fair to take account of the number of lives saved by these devices as well as of the number of fatalities caused by them.

What, then, are the physiological conditions which the Tissot apparatus satisfies, thereby putting its wearer in possession of all his normal powers?

In the first place, it utilizes nasal respiration by means of two tubes hermetically fitted to the nostrils. Breathing through the mouth, indeed, is abnormal and fatiguing. Again, the ingoing and outgoing air currents are kept separate. The exhaled air goes to the regenerator (the tin box), and thence to a pouch of impermeable canvas inside of the bag. Oxygen is supplied by a tube containing 300 liters (634 pints) of the gas (compressed), and is consumed at the rate of 2 liters (about 4 pints) per minute during active labor and 1 liter per minute in walking.

Tissot has eliminated valves, which embarrass respiration by affecting the pressure of the inhaled and the exhaled air, and helmets, which are never air-tight in practice. The carbonic acid exhaled is absorbed by a solution of caustic potash placed in the regenerator. Solid caustic potash absorbs very well at first, but very poorly afterward, especially when the production of carbonic acid is augmented by muscular work. This fact explains many fatalities among life-savers equipped with certain forms of respiratory apparatus.

In the types which employ sodium bioxide the difficulty of absorbing the carbonic acid is still greater, for the bioxide soon becomes covered with a layer of sodium carbonate (five or six times less soluble than potassium carbonate) which protects the rest of the mass. There is still another source of danger in apparatus of this class. The disengagement of oxygen is almost a matter of chance, since it is governed by the proportion of water vapor contained in the exhaled air.

Tissot's new apparatus is not a great incumbrance to the wearer. It weighs only 28 pounds and is carried on the back, over which the weight is well distributed. The entire suppression of bags or other apparatus in front leaves the wearer free to crawl on his hands and knees, to use a pick or other tool, in short, to do almost any kind of hard work.

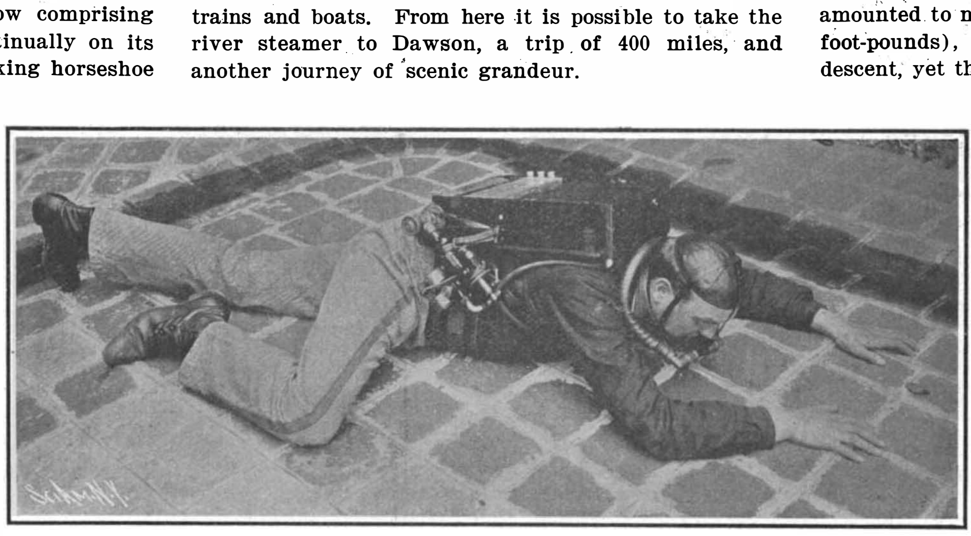
The superiority of the apparatus to its predecessors was strikingly demonstrated in the following experiments. A man equipped with the Tissot apparatus walked five hours without experiencing any difficulty in breathing. At the end of the experiment the inhaled air contained only 0.86 per cent of carbon dioxide, 280 liters (592 pints) of oxygen were consumed.

On another day the same man made 50 ascents and descents of a stair 7.65 meters (25 feet) in height, without stopping, and afterward accomplished 37 additional ascents in six "heats," with intervening pauses.

In the course of this test—which continued three hours and was terminated by fatigue of the legs due to lack of training—the positive work of ascent amounted to more than 60,000 kilogrammeters (440,000 foot-pounds), in addition to the fatiguing labor of descent, yet the rhythm and fullness of respiration remained unchanged to the end. Only 300 liters (634 pints) of oxygen and 1,800 grammes (4 pounds) of potash were consumed.

Finally, Dr. Tissot tested the stanchness of the apparatus by wearing it himself and remaining four hours in an atmosphere of illuminating gas. He experienced no abnormal sensations. It is true that he used a gas bag with double walls in this experiment, but experiments with guinea pigs have proved that only negligible quantities of carbonic oxide penetrate into the single linen bag of the standard Tissot apparatus.

The employment of this apparatus, therefore, appears to be indi-



THE TISSOT APPARATUS LEAVES THE CHEST AND ARMS FREE FOR WORKING OR CREEPING.

cated in mines, in conflagrations, in emptying wells, cesspools, etc. And one point of capital importance deserves especial emphasis. This apparatus makes possible, for the first time, prolonged work in an irrespirable atmosphere. Hence it permits extensive repairs to be made without stopping the operation of smelting furnaces and blast furnaces.

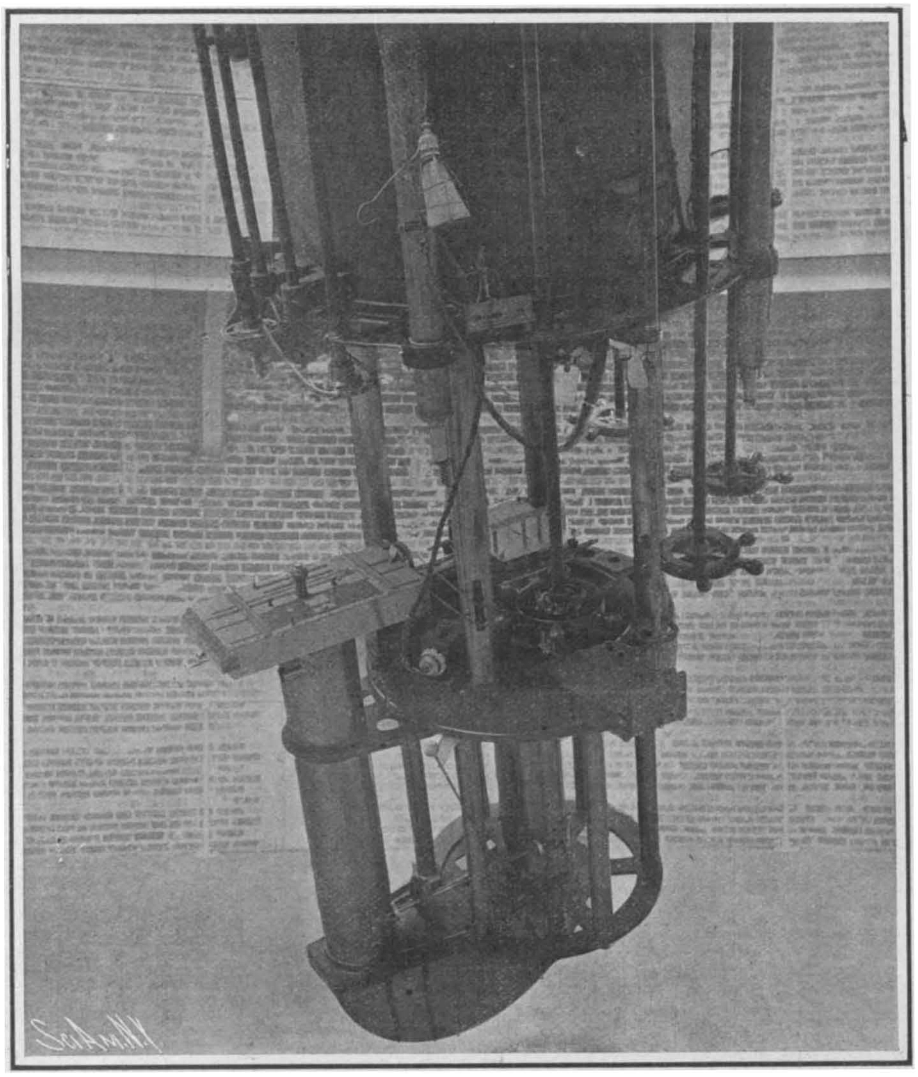
GREAT STORMS ON THE SUN.

BY DR. S. A. MITCHELL OF COLUMBIA UNIVERSITY.

For some months past great popular interest has been taken in the sun. This is chiefly due to the fact that an unusual number of sunspots has been observed, and that each new discovery has been heralded far and wide by the daily press. Some of these spots have covered a great area on the sun, the group of November 14, the day of the transit of Mercury, 100,000 miles in diameter, being readily seen by the naked eye. On the evening of the same day, there was a splendid display of northern lights. This was not a chance coincidence of aurora and sunspot group; it has been recognized for some time that there has been an intimate connection between the two, and when a large spot is central on the sun, we may look for an auroral display. Northern lights are rather elusive phenomena, and they are not always observed when looked for, but ably know comparatively little about them. The spectroscope has come to the aid of the astronomer, and has given us a ready means of a daily study of the solar furnace as revealed by the flames which shoot up from its surface. That the spectroscope, which tells of the chemical constitution of the sun and distant stars, can show us the *form* of these red flames seems well-nigh impossible, but such is the case nevertheless. This it does in virtue of the fact that the flames about the sun are masses of gas, mainly hydrogen and calcium, heated to an enormous temperature. But glowing gas gives a spectrum of a few bright lines on a dark background in contradistinction to the spectrum of the sun, which shows many fine dark lines on a bright background. By a peculiar use of the spectroscope, the solar prominences can be viewed in all their detail without its being necessary to wait for the few minutes of a total eclipse. And not only can these darting flames be thus seen with the naked eye, but a permanent record of them can be made on a photographic plate, in spite of the fact that the dazzling light of the solar surface is hundreds of times brighter than these outbursts from the sun. These photographs are made by a special form of instrument called the spectroheliograph. This was devised by Prof. Geo. E. Hale, former director of the Yerkes Observatory, at present director of the Solar spectrum, or in that of burning hydrogen if the *F* line is employed.

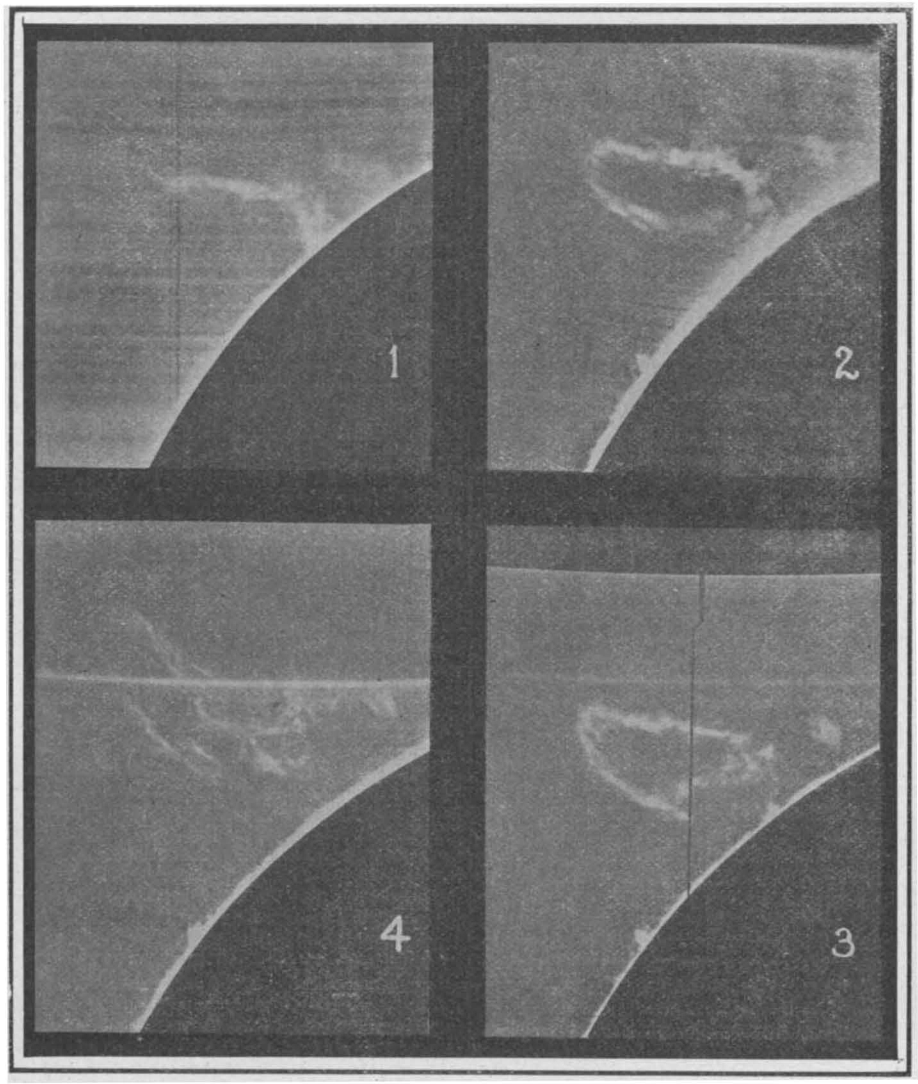
Photographs are taken almost daily at the Yerkes Observatory by Mr. Philip Fox for the purpose of recording the prominences. These cannot be seen with the naked eye or with the telescope alone, and become visible only after a photograph is taken and the plate developed. On the original photograph the sun, 866,000 miles in diameter, appears as a seven-inch circle. The heights of the prominences are thus easily measured.

A plate taken by Mr. Fox on the morning of May 21, 1907, upon development showed a prominence of unusual size in the southwest quadrant. Upon returning to the telescope as soon as possible a series of photographs were taken, four of which are here reproduced in order to show the activity of this phenomenon. Between Fig. 1 and Fig. 2, fifty minutes of time intervened; between Fig. 2 and Fig. 3, only nine minutes; and between Fig. 3 and Fig. 4, thirty-four minutes. The rapidity of these changes can be imagined, when it is realized that this prominence was more than 100,000 miles in height. A comparison of the photographs shows that the peak of the prominence as seen in Fig. 1 toppled back to the sun, forming the loop in Figs. 2 and 3. Fig. 4 shows the flame in rapid disintegration. Though this storm of May 21, 1907,



In principle the instrument is a spectroscope, but with the addition of a second slit placed close in front of the photographic plate. The second slit cuts off all but that portion of the solar spectrum to be photographed.

Rumford Spectroheliograph Attached to the 40-inch Yerkes Telescope.



1.—10:02 A. M. Height 100,700 miles. 2.—10:52 A. M. Height 114,200 miles.
4.—11:35 A. M. Height 172,400 miles. 3.—11:01 A. M. Height 123,200 miles.

Solar Outburst of May 21, 1907, Photographed by Fox at the Yerkes Observatory.

GREAT STORMS ON THE SUN.

the connection is none the less a very close one. The astronomer does not quite understand the nature of the eruption on the sun that manifests itself as a sunspot, or why these spots should be much more numerous in some years than they are in others.

The sun is an enormous roaring furnace, hotter than any blast or electric furnace that we can construct, with a temperature greater than any we can make artificially on earth. The flames that make up this solar furnace ordinarily do not leap to great altitudes; but once in a while a tongue of fire darts out with an enormous velocity from the sun's edge, and reaches up to hundreds of thousands of miles. Such an eruption occurred on November 13, 1907, rising to the terrific height of 352,000 miles.

The light of these flames or prominences, as they have been called, is so feeble compared with sunlight, that it is never possible to view them with the telescope except when the moon covers up the dazzling white light of the sun, causing a total eclipse. At such a time, though most interested in the beauties of the corona or crown of glory about the sun—the most beautiful of all natural phenomena—the eye can still take cognizance of the red flames close to the edge of the dark moon.

If we were confined to the few minutes of a total eclipse for the study of prominences, we would probObservatory of the Carnegie Institution. The instrument has reached its greatest perfection in connection with the great 40-inch telescope of the Yerkes Observatory. The illustration shows the Rumford spectroheliograph attached to the great telescope. In principle the instrument is a spectroscope, but with the addition of a second slit placed close in front of the photographic plate. This second slit serves the purpose solely of cutting off all of the solar spectrum save that portion with which it is wished to photograph. If the secondary slit is set at the *K* line, and the solar image be allowed to pass over the first slit, we will get an image of the sun in the light of the material which gives the *K* line in the spectrum. This *K* line tells us there is calcium in the sun, and if this calcium is in the form of vapor or gas heated enormously and glowing, it will be a bright line. The spectrum of a prominence consists of a series of bright lines, and from the position of these lines it is evident that hydrogen and calcium are there and heated to a very high temperature. The great focal length (62 feet) of the Yerkes telescope produces an image of the sun seven inches in diameter. If a disk of this size is placed at the slit of the spectroheliograph so as to cover up the sun, it will be possible to take a photograph of the solar surroundings in the light of glowing calcium vapor by using the *K* line of the

did not reach the enormous heights that are sometimes attained, still this display of solar prominences was most interesting from the fact of their rapid changes, matter moving at the rate of fifty miles per second.

Death of Garrett P. Serviss, Jr.

Garrett P. Serviss, Jr., who occasionally contributed papers to the SCIENTIFIC AMERICAN on aerial flight and similar subjects, died at Ithaca, N. Y., on December 23. He was born in Brooklyn on January 3, 1881. He gave promise of winning a high place by his mathematical and literary talents. Unfortunately, for two years past he had been incapacitated by ill health from pursuing his studies. He was well known in track athletics, having a few years ago made the indoor college record in the high jump—6 feet 1 inch.

Automatic Point Adjuster.

Some time ago an experimental automatic point adjuster was put down on the tram lines in Sheffield, England, and has so successfully stood a long test that the same form of apparatus is being adopted at all important junctions in the city. The automatic device is operated by the electric current, and adjusts both the rail and the cable points. Each one dispenses with the services of two men, and effects a considerable saving of expense.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

CASKET-HANDLE. — J. D. Lawrence, Princeton, N. J. The invention comprises a head with a lug, means for securing the former to the side of the casket, a drop arm with a head and a lug integral with the head, a pin extending through the lugs and terminating substantially flush with the outer edges thereof, and an inclosing member with an opening into which the lugs extend, the opening being further provided with surfaces against which the heads of the pins loosely fit.

KNOCKDOWN CRATE. — A. Williman, Washington, Mass. The construction in this case admits of the members of the crate being expeditiously and conveniently separated and packed in a small compass, and as readily and quickly set up to receive merchandise, and wherein the cover can be quickly and handily placed and locked in position or unlocked and removed from the body of the crate.

DART FOR BLOW-GUNS.—C. E. Stivers, Denver, Col. The invention permits the convenient insertion of the dart into the gun, and insures the proper binding action of the body of the dart on the wall of the bore of the gun during the propulsion of the dart through the bore, thus requiring less physical exertion on the part of the user for propelling the dart a long distance with great accuracy and swiftness.

CHALK-LINE HOLDER.—A. B. Sharp, Atlanta, Idaho. Mr. Sharp's invention has reference to wood-working tools, and his object is to provide a new and improved chalk line holder arranged to insure a thorough chalking of the line when unreeling the same and drawing the line into chalking position.

TILE.—P. J. McGuire, New York, N. Y. The aim in view in this case is the provision of a tile or the like wherein a permanent fastening of the same is insured when set; also to provide for the shielding of the tile from the moisture of the cement used to hold it in place, whereby the glazed face of the tile will not craze by reason of the unequal expansion and contraction ordinarily caused by said moisture.

HARNESS-HANGER.—F. Hof, New York, N. Y. The device is for use in engine houses, truck houses, and the like. The purpose of the inventor is to provide a single piece hanger, adapted both as a rest and a release for parts of a harness and accompanying rocker being so constructed that the breeching of the harness will be supported by the rear portion of the hanger and the hames and reins by the said rocker, located at the forward portion of the hanger.

AERIAL VESSEL.—G. Halliday, Superior, Wis. This device is under absolute control of the operator, and is capable of creating and using a cross current of air, and also provides in connection with its construction a perpendicular centrally located sail, that is a means of safety, since it is buoyant and serves as a ballast to keep the boat or car in proper position and the ship as a whole in perpendicular position.

RECEPTACLE FOR POWDERED SUBSTANCES.—Y. K. Buell, New York, N. Y. The more particular object in this invention is to produce a receptacle especially adapted for holding pepper or salt, and for allowing the same to be readily shaken out. Means are provided for varying the outlet of the receptacle, in such manner as to regulate at will the quantity of the substance discharged when the receptacle is shaken.

HAMMOCK-SUPPORT.—C. H. Banks, Atlanta, Ga. The invention pertains to canvas hammocks such as are used in prisons. Its object is to provide a new and improved hammock support arranged to permit convenient attachment to a prison bar of a grating, and to insure proper hang of the hammock and comfort to the user.

Machine and Mechanical Devices.

CURRENT WATER-WHEEL.—A. A. Porter, Naugatuck, Conn. The object of the invention is to provide a wheel, simple and durable, and arranged to revolve in either direction, without change in the direction of the current or the location of the wheel in the current, and to allow of using the wheel in either a vertical or horizontal position.

SLICING-MACHINE. — F. D. Prettyman, Watsonville, Cal. The design in this case is to provide a machine for rapidly and symmetrically slicing apples and other familiar fruits or vegetables into equal segments. The apples are to be cored and preferably peeled and are fed by hand on to a series of vertical guide posts, like spools on a spindle, and are forced down by a follower between and through a series of radial cutting knives concentrically arranged about the posts.

SELF-FEEDING SAWING-MACHINE. — J. A. Meeks and F. C. Kaiser, Muncie, Ind. The object here is to provide a machine arranged to automatically adjust the positive feed to varying thicknesses of the material to be sawed, to protect the circular saw and the operator, to allow of throwing the feed out of action or stopping the feed instantly, and to permit variation of the feed according to the nature of the wood to be sawed.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

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(10653) P. H. asks: 1. Does ether count for anything when it comes to a perfect vacuum? A. The ether of space is not considered in estimating a vacuum. Only the air or other ordinary gases can be pumped out of a receiver. Ether is far too tenuous to be pumped. It can pass through any known material as easily as light passes through glass. 2. How near to a perfect vacuum has been gotten? A. We cannot say how near a perfect vacuum has been reached. It is very easy to exhaust to less than a millionth of an inch. The vacuum of an X-ray tube in use rises higher still by the absorption of the gases by the electrodes.

(10654) W. F. T. asks for the date of the first cut nails made. A. Cut nails in the strictest sense of the term, i. e., nails cut from sheet metal of the thickness of the nail, were first made by Jeremiah Wilkinson, of Cumberland, R. I., in 1775. Ezekiel Reed, of Bridgewater, Mass., patented a machine for performing the same operation in 1786 and obtained a later patent for cutting and heading, in one operation. Numerous patents for improvements followed, 23 having been issued by the end of the century, and Perkins's machine, patented 1795, is said to have turned out 200,000 nails per day. In a broader sense, cut nails as distinguished from drawn or wire nails antedated the latter by nearly two centuries, a patent having been granted in England in 1606 to Sir Davis Bulmer for a machine to cut nail rods by water power, all nails having been previously forged from the bar, whereas the first nail drawing machine was patented by Thomas Clifford in 1790.

(10655) J. W. P. asks: Can you give me a glue or cement preparation which can be used on deadening felt and which will withstand heat? Also a preparation which will render the felt fireproof? If there is more than one preparation of each kind, I would like the cheapest. Can the two preparations be combined into one? A. We are glad to recommend the following preparations: Cement for attaching felt to wood or iron: 16 parts gutta percha, 4 parts caoutchouc, 2 parts pitch, 1 part shellac, 2 parts linseed oil. Heat the first until liquid and add the others in order, stirring thoroughly. Good glue, to which tannin has been added until the glue becomes ropy, is also useful for this purpose and cheaper, but will not stand so high a degree of heat; it is fairly secure up to 150 deg. F. Adding quick lime to ordinary glue will render the glue fireproof, but it will not sufficiently permeate the felt to fireproof the latter. The felt had better be soaked first in a solution of the following proportions: Boracic acid, 6 parts; sal ammoniac, 15 parts; borax (pure), 3 parts; water, 100 parts.

(10656) E. M. writes: On a mountain top a bell is rung which can be heard one mile and no further. On a certain day all living beings remove to a distance of two miles; the bell is then rung by some electrical or other agency. Will there be any sound on this mountain top? The propounder of the question answers, "No," and gives this reason: For the production of sound three agencies are required: The striking of the bell, vibration of the air, and the ear of some living object to receive the air waves. A. The question is a very old one and has been a subject of protracted and heated discussions. Perhaps the best way to reach an understanding of the matter is to refer to some good English dictionary for the definitions of "sound." You will find two at least; one will be "The sensation produced through the agency of the auditory nerve by certain vibratory motions of matter." The other will be "A vibratory motion of a material body which can affect the auditory nerve." The first is the physiological definition, the second is the physical definition of the word sound. There need be no wrangling over the matter. State the sense in which the word is employed. In books upon physics the word is employed in the second sense, and a sound does not require an ear to hear it. The number of vibrations in the tone of the supposed bell on the mountain top may be recorded upon appropriate apparatus, and the tone determined by one who is totally deaf, with absolute accuracy.

NEW BOOKS, ETC.

A Handbook of the Philippines. By Hamilton M. Wright. Chicago: A. C. McClurg & Co. With 3 maps and 143 illustrations, appendix and index. 12mo.; cloth; 431 pages. Price, $1.40 net.

The question, "What shall we do with the Philippines?" is frequently asked, and not infrequently answered. It is astonishing, though, how little interest the people of the United States take in this serious problem, especially so when one considers that these islands are both profitable markets for our goods and natural gateways to the trade of the Orient. Mr. Hamilton M. Wright's "Handbook of the Philippines" should do away with a great part of our indifference to these insular possessions; an indifference largely due to the previous lack of readily obtainable, up-to-date information on the subject. He spent a period of some months traveling over the islands, taking photographs and collecting data. These he has embodied in a work showing the present condition, possibilities, and strategical importance of our outpost in the Far East.

River Discharge. Prepared for the Use of Engineers and Students. By John Clayton Hoyt and Nathan Clifford Grover. New York: John Wiley & Sons. 8vo.; cloth; 137 pages, illustrated. Price, $2.

Considering the paramount importance of water supply, and the vast economic and industrial interests which are vitually dependent upon it, it is a little strange that reliable and accurate information on the subject is difficult to obtain. On the important question of the measurement of stream flow, much that has been published is scattered through government pamphlets, and has not previously been collected. In this volume the authors have compiled the best information from all available sources, dealing both with the practical side of the work—the choice of station sites, the various methods of gaging, etc.—and with the interpretation of the data obtained. They give the information in a clear, practical manner, and the book will prove valuable to the engineer who has in any way to consider the problem of water flow.

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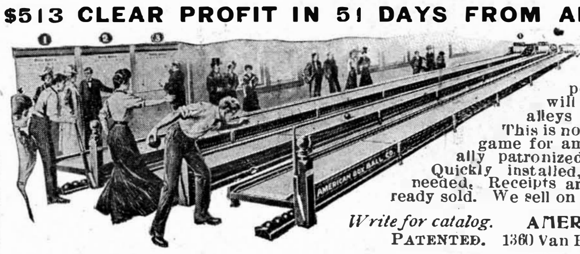

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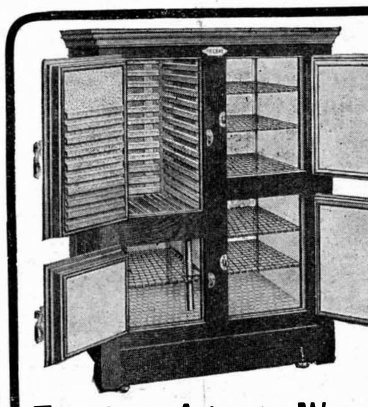

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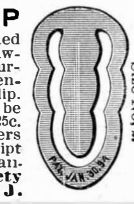

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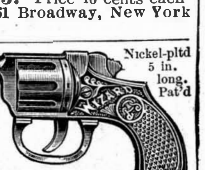

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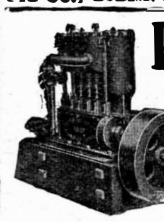

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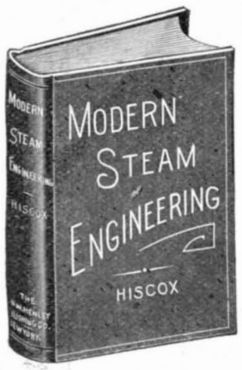

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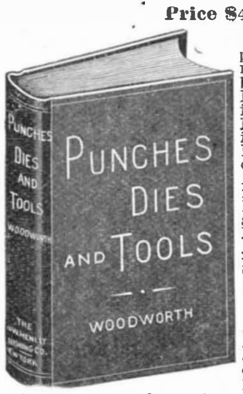

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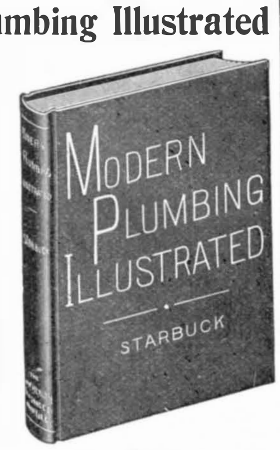

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"Munson's Ye-Ti-Va Remedy," for medicine, J. G. Munson ... 13,959
"Punch-I-Nello," for soft drinks, W. E. Borden ... 13,955
"Royal Cake Icing," for cake icing, Royal Pure Food Co. ... 13,957
"Sinn Fein," for cigars, E. E. Kirkland & Co. ... 13,954
"Tanaline Cream Lotion," for a lotion for the complexion, Damascus Chemical Co. 13,958
"The Grote Billiard Balls," for billiard balls, Newark Billiard Ball & Mfg. Co. ... 13,962
"The New Grote Pool Balls," for pool balls, Newark Billiard Ball & Mfg. Co. ... 13,963
"Whitman's Kilrat Exterminator," for rat exterminator, J. F. Whitman ... 13,961

PRINTS.

"Men's and Boys' Apparel," for men's and boys' apparel, H. C. Lytton ... 2,188

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.