SCIENTIFIC AMERICAN

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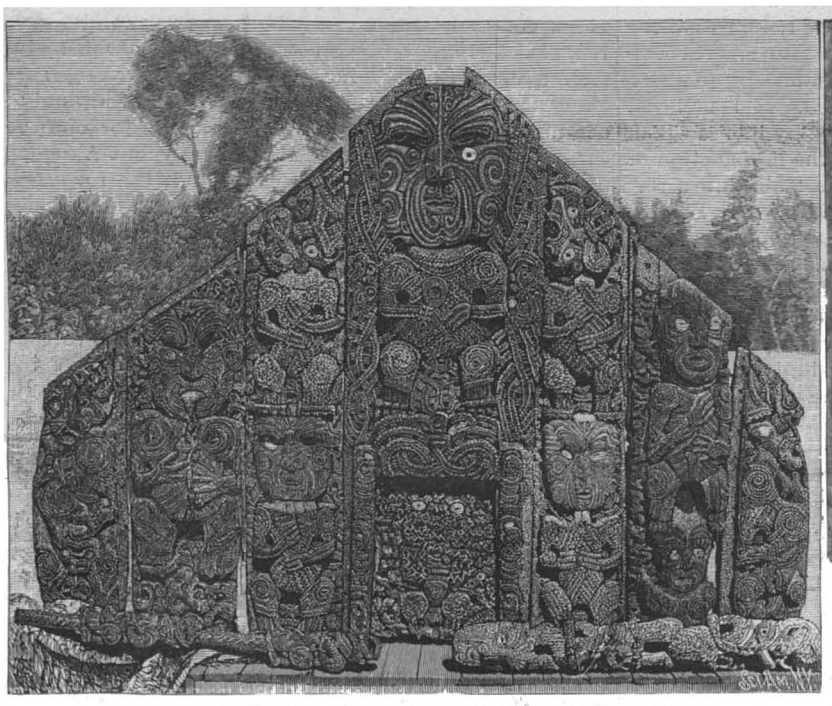
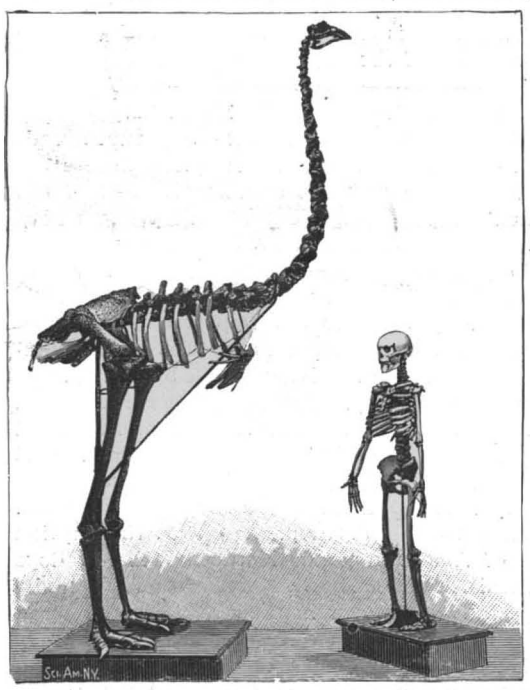
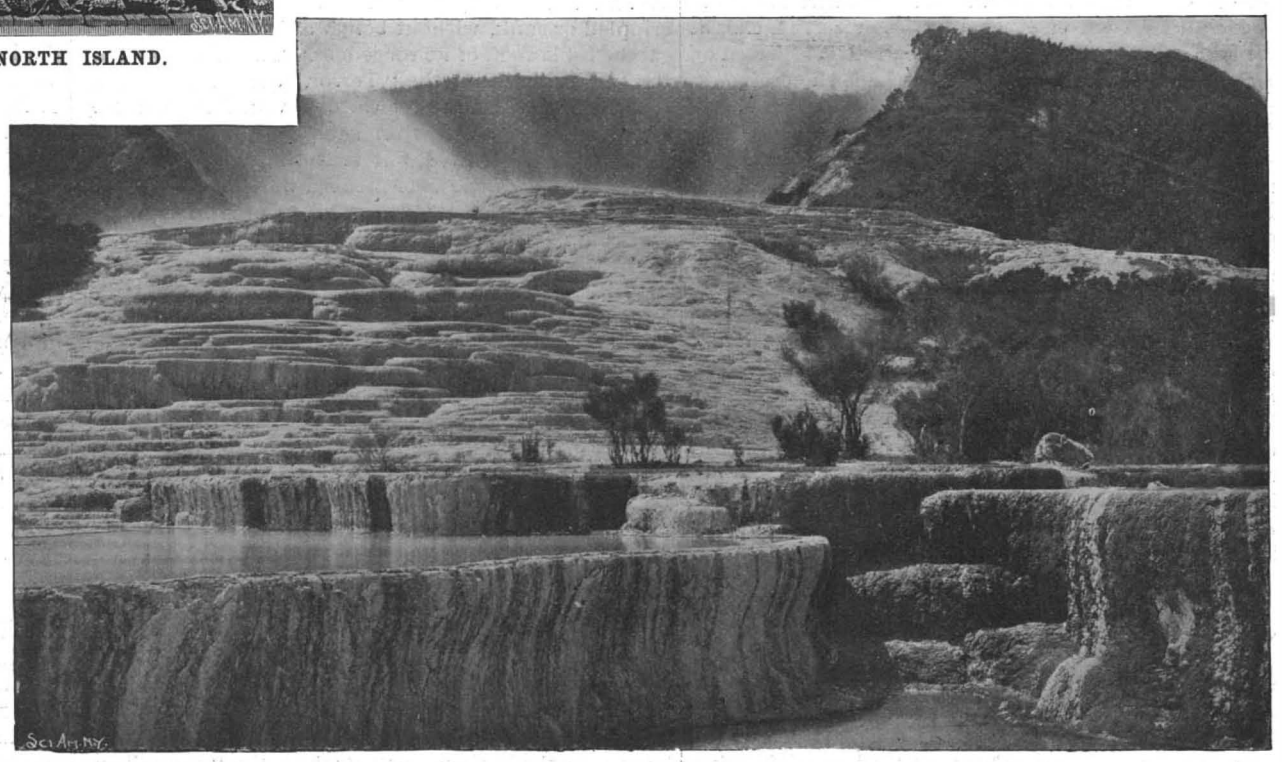


FRONT OF TRIBAL ASSEMBLY HOUSE, NORTH ISLAND.

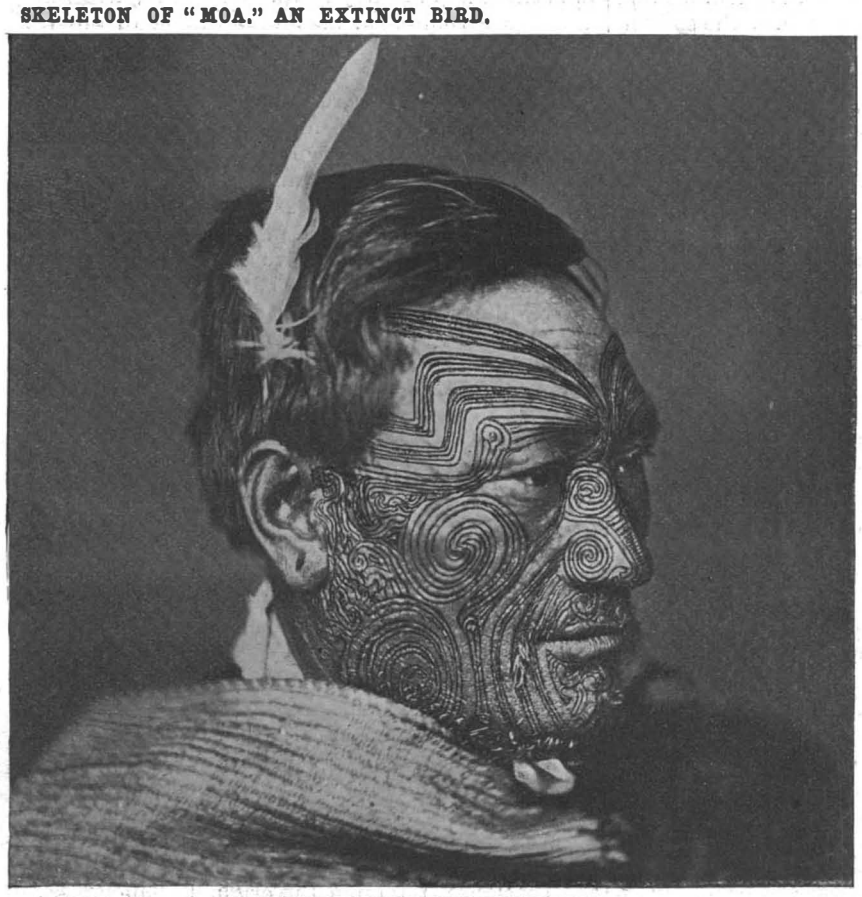
MAORI VILLAGE—PIPIRIKI, WANGANUI RIVER KING COUNTRY.



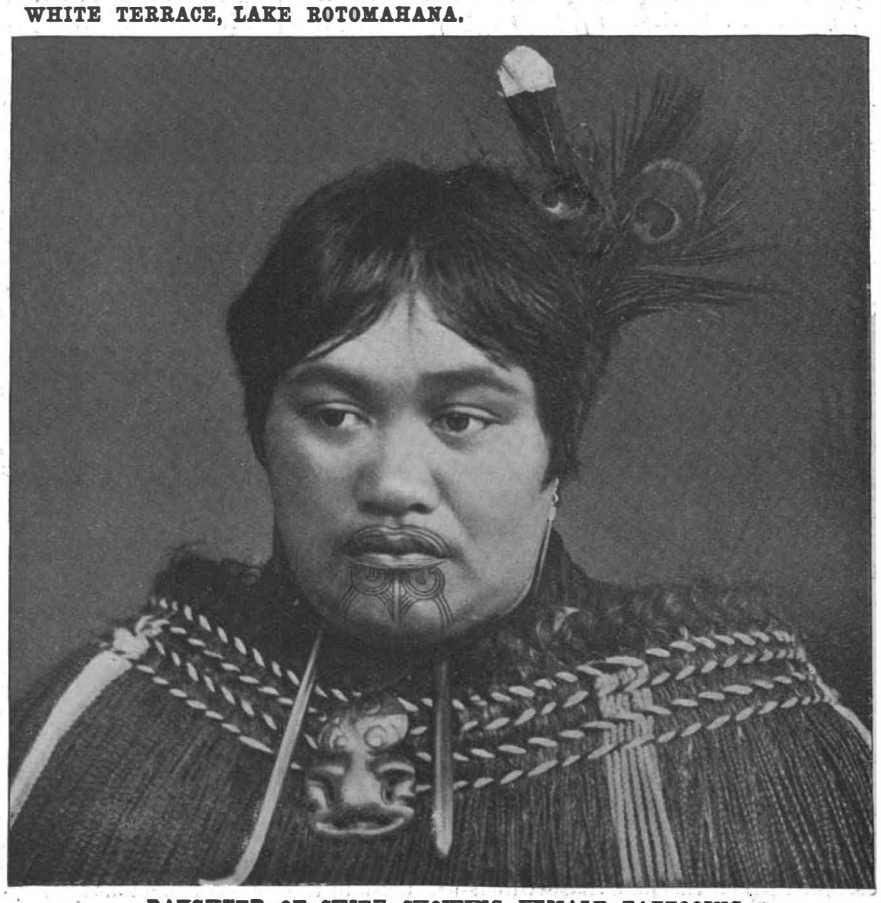
SKELETON OF "MOA," AN EXTINCT BIRD.



WHITE TERRACE, LAKE ROTOMAHANA.



SPECIMEN OF MAORI TATTOOING.



DAUGHTER OF CHIEF, SHOWING FEMALE TATTOOING.

PICTURESQUE VIEWS IN NEW ZEALAND.—[See page 233.]

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NEW YORK, SATURDAY, OCTOBER 8, 1898.

NEW CHEMICAL DISCOVERIES.

It is doubtful whether as many discoveries of new elements have been made in as many years as in the three or four months since the first of June. In every instance the announcement of the discovery has been supplemented by complete proof, without which, the scientific world would be loth to accept the discovery. The amount of chemical research necessary to detect these new elements has been enormous.

A pronounced sensation was created in 1895, when Lord Rayleigh and Prof. Ramsay discovered the existence of a gas previously unknown in the atmosphere which they termed "argon." It resembled nitrogen in being inert and unwilling to make combination with other elements. A few months after Prof. Ramsay discovered alone, in a mineral brought from Sweden, the gas helium, which up to that time had been found only in the sun and a few stars. The Russian chemist Mendeleeff has devised a table which is considered of great importance by chemists, as by it the elements can be easily arranged according to chemical law, based on the tendency of the elements to arrange themselves in classes in which the numbers would have certain properties in common, and it has been found that a regular ratio would then prevail between the atomic weights of the elements of the class so formed. By reason of this law Prof. Ramsay suspected that an element not yet detected existed, and that when found, it would possess an atomic weight between that of argon and helium. We have already referred to his paper before the British Association at Toronto, and his discovery has also been stated. Last June he announced that with Mr. Travers he had discovered a new element which did not fit in the designated place in the scale, but was related to argon. This was the gas "krypton," which was obtained directly from argon. These two English chemists pursued their investigations and found two other substances combined with argon. They had different weights and spectra from each other, from argon and from krypton. One was named "neon" and the other "metargon."

Following close upon the heels of the last two elements came the announcement of two others, one from France and one from America.

Two or three years ago M. Becquerel the French chemist reported that uranium salts threw off an invisible radiation, something like that discovered by Prof. Roentgen. Following up this line of inquiry, M. and Mme. Curie found that a variety of pitch blende possessed this characteristic in a far higher degree. This led them to believe that the mineral contained a new element. Up to the present time they have not succeeded in isolating it entirely, but they had reported to the French Academy of Sciences that they had obtained it in the form of a sulphide and they proposed to call the element "polonium." The new substance resembles bismuth, but is of far greater radiating power than uranium.

Mr. Charles F. Brush read a very important paper before the American Association for the Advancement of Science at its Boston meeting, in which he describes the experiments which he has been carrying on for a year or two in eliminating from the atmosphere a gas which is lighter than hydrogen and which he believes he has succeeded in doing. The new substance has been called "etherion," and if his supposition is well founded, the element will probably exceed "coronium" in lack of weight and density. Mr. Brush says that the ability of etherion to conduct heat is fully a hundred times as great as that of hydrogen, from which he bases arguments on the velocity of its molecules. Mr. Brush considers that a gas possessing these peculiarities cannot be confined to the earth, but must reach out indefinitely into space. Mr. Brush suggested the possibility of several new elements besides etherion being found in the atmosphere and that all of them may prove to be lighter than hydrogen.

The latest announcement of the discovery of a new element was made by Sir William Crookes, in his presidential address before the British Association for the Advancement of Science. He had been examining certain rare earths like those which are used in the manufacture of the Welsbach mantle, and in the spectrum of a part of a specimen which had been isolated from the rest, he discovered lines that were unrecognizable. Eventually he found that he had discovered a new element, and he is now making investigations on it. He has been able to determine, however, some of its properties. It is heavier than "yttrium," but lighter than "lanthanum," its atomic weight being estimated at 118. It shows a marked disposition to combine with other elements. The characteristic lines of its spectrum are in the ultra-violet and stand alone, and from this latter circumstance Sir William has decided to call it "monium."

In addition to the discovery of these elements the discovery of terrestrial "coronium" is most interesting and is one of the greatest scientific triumphs of the year. It is hoped that soon Prof. Nasini and his collaborators will be able to obtain a sufficient quantity of this gas so that it may be liquefied. It is believed that a degree of cold may be obtained by its use which will exceed that which results from the liquefaction of hydrogen and may even touch the "absolute zero," which is hypothetically placed at minus 273°. It is assumed that this temperature probably represents that of interstellar space. The Italian chemists are hoping to find the other substances in connection with coronium. As the year 1896 was rendered memorable by the discovery of Prof. Roentgen, so the year 1898 will be celebrated as one of unparalleled importance as regards the world of chemistry, and the theater of action has in this case extended over a number of countries.

THE LIMITATIONS OF THE TORPEDO BOAT.

There is no disputing the fact that the torpedo boat operations of the Spanish war have cast a certain amount of discredit upon this type of vessel. On the few occasions in which torpedo boats were in action the results were such as to leave this much dreaded engine of war shorn of its terrors, at least in the popular mind. In every case the torpedo boat was either crippled or sunk, without being able to make a single successful launch of its torpedoes. The disablement of the "Winslow" and the "Terror," the tragic sinking of the "Furor" and the "Pluton," would seem, at first sight, to demonstrate that such craft have not only been greatly overrated, but that they are practically useless for the purposes of modern warfare.

As a matter of fact, these reverses prove nothing of the kind.

The torpedo boat is a highly specialized engine of war, designed with sole reference to a particular kind of attack, and admittedly useless for any other purpose. In every instance mentioned above it was dispatched to do work for which it was never intended and for which it was utterly unfit. Hence the disasters which overtook it were natural and inevitable. At Cardenas the "Winslow," carrying three little 1-pounder guns, was sent into a harbor against gunboats which were armed with quick-firing rifles of considerable power. She ran into a zone of fire which quickly crippled the boat and decimated her crew. The "Terror," armed with 12-pounders and 6-pounders, attempted in broad daylight to steam across several miles of intervening water and torpedo the "St. Paul." The latter was armed with long range 5-inch rapid-fire rifles and a good battery of 6-pounders, and working on the stable platform afforded by the lofty deck of the liner, her gunners quickly disabled the little craft, and drove her back into the harbor. At Santiago the "Furor" and "Pluton" deliberately steamed out into the concentrated fire of four battleships and an armored cruiser. The inevitable followed, and in a few minutes they were riddled and sinking. These results simply prove that the torpedo boat is a very positive failure if engaged outside of its own proper sphere of action.

In the first place, the torpedo boat was never intended for daylight work of any kind whatsoever. To use torpedo boats by day is as reasonable as to anchor buoyant submarine mines in full view at the surface of the water. Invisibility is essential to torpedo boat attack, if it is to be conducted with any prospect of success. The little craft is constructed with the expectation that it will never attempt a stand-up fight in which blow is given for blow, and hence its flimsy skeleton and fragile shell are made of barely sufficient strength to carry its load of coal, torpedoes, and crew, and endure the throbbing of its swiftly running engines. As far as protection from even the rifle fire of the enemy is concerned, her crew and engines might as well stand exposed in the open.

The sole *raison d'être* of the torpedo boat is to be found in the destructive power of the torpedo when it is once brought within launching distance of a battleship or cruiser. The torpedo boat is designed for the express purpose of bringing the torpedo within range, firing it, and, if possible, making its escape from the rapid-fire guns of the enemy.

The early torpedo boats were of 80 to 120 tons displacement. Their small size greatly aided them in escaping observation, and there is no question that the larger torpedo boats, known as destroyers, lose much of their value for attack on account of their increased and conspicuous size. The destroyer was primarily intended as an answer to the torpedo boat. It was given increased size, speed, and armament in order to enable it to run down and disable the torpedo fleets of an enemy, the first of these craft being constructed by England as a defense against the numerous torpedo flotilla of France. But the increased dimensions that made these vessels good destroyers rendered them poor torpedo boats, the feature of invisibility being largely sacrificed to speed and armament.

Is the torpedo boat destroyer a success? As a protection against torpedo boats it is; but for service as a torpedo boat against battleships it is not. For, in addition to its visibility on account of its size, it offers a larger target for attack, and the noise, disturbance of the water, and rush of flames from its funnel, all due to its enormous engine and boiler power, render the risk of detection trebly great. Only those who have seen a 5,000 or 6,000 horse power destroyer tearing along at night under the influence of forced draught can understand how impossible it will be for one of these vessels to escape detection on any but a foggy night. The terrific rush of air through the furnaces carries flame and hot coals through the smokestacks, from the top of which it often issues in a bright column of flame. What better signal of its approach could the lookout on a battleship desire?

There is, however, one method of using the destroyer or torpedo boat which might prove to be fatal to the strongest fleet, even in a daylight attack. We refer to the method of attack by overwhelming numbers, in which a dozen or more of the little craft make a simultaneous dash on all sides upon a battleship. Here, we are free to confess, the chances of success lie strongly on the side of the many against the one. There is no battleship that could reasonably hope to sink every one of a dozen torpedo boats in the one and a half minutes intervening between the time they came within range of the battleship's guns and the time when they fired the torpedoes. If she sank four or five, she would be doing wonderfully good shooting, and five torpedo boats would represent less than one-third the cost of a single battleship. It is possible that the torpedo boat's destroyer may yet be the battleship destroyer as well. Such, at any rate, is the opinion of one of the greatest naval strategists of the day.

OUR FAULTY TRADE METHODS.

It is a fact that, while we are able to produce goods of a high quality and at the lowest price, we are not always able to sell them to advantage. One of the most valuable offices which our consuls perform is to gather information abroad as to the methods in vogue in conducting business, and also in giving advice as to how we may extend our markets. This information is forwarded by them to the Department of State, which in turn prints the reports and tries to disseminate the information as much as possible by giving these reports a wide publicity. The newspapers are supplied with advance sheets of consular reports and interested parties are furnished with them without expense. One of the most valuable collections of hints of this nature is given by Consul Marshal Halstead, of Birmingham, who writes to the department under the caption "Faults of American Trade Methods." A few days ago Mr. Halstead was shown sixteen letters from sixteen firms, all well known in their respective lines, in the United States. On twelve of these letters there was insufficient postage, most of them having only a two cent stamp to carry them. Of course, this meant that the Birmingham man who wished to buy from some of these American firms had to pay double the deficiency of the postage, which would tend to give him a bad opinion of the carelessness of American business methods. Our business methods compare favorably with those of any country in the world, and are perhaps better, but we cannot afford to get a reputation of having bad business methods by inattention to even such small matters as this. Steamer mails from the United States frequently arrive after business hours on Saturday, and if there is a deficiency in postage, the letter will not be delivered at hotels, etc., until Monday, so that the traveling representative often loses valuable time waiting instructions from home, which cannot be promptly delivered, owing to the letter being insufficiently stamped. One American house tells this agent that a deficiency of postage is a guarantee that a letter will be delivered to the right party, as no one else would pay the postage in order to get the letter!

There is no question that mulcting foreigners in these small sums is a petty annoyance which has some effect on American trade. If an English or Continental house sends a telegram, a letter always follows, even to points nearby, containing a copy of the telegram. Few American houses do this even with cablegrams, and many important messages would be delivered in time if this were done. If a letter is sent to a foreign point, a letter-press copy follows by the next steamer as certainly as the second bill of exchange follows the first. With bills of lading the European house does not depend upon the triplicate copy forwarded by the shipping agent, but itself sends a duplicate copy to the consignee, retaining the original. The American houses constantly neglect to do this; so that Ameri-

can goods are constantly being held at foreign custom houses.

Another point which Americans are apt to neglect is the discrepancy in weights and measures between those abroad and our own. In Great Britain jewelry is measured on the arbitrary system of measurements called "forty-line scale," which means forty lines to the inch, instead of one-twelfth of an inch, which we usually understand to mean a line. A declaration was sworn to before Mr. Halstead of returned American goods, the Birmingham manufacturer having ordered from an American manufacturer a lot of "indestructible pearl," giving the measurement he required in lines. Not knowing what lines meant, the American, without inquiry, had recourse to the metric system. By this time the American manufacturer has undoubtedly received his goods, which are of a size which will render them valueless. A few weeks ago $500 worth of fountain pens were returned to a manufacturer because they were not like the sample, although they were superior to it. From what has been already said, it will be seen that Americans, to be successful in foreign trade, must pay attention to the methods of conducting business in vogue abroad, and must particularly attend to postal matters, and must in all cases follow instructions implicitly as to measurements and shipping.

HOSPITAL ARRANGEMENTS IN THE SOUDAN.

It is interesting at this time of criticism and complaint to note the elaborate arrangements made by the British Army Medical Department for the final advance on Khartoum. Of course it should be remembered that the conditions which prevail in the Soudan army are much worse than anything which our medical officers have had to contend with, and in no case was the American army ever more than two or three days' sail from the base of supplies, while the British army is in the heart of Africa.

The arrangements made for the treatment of General Kitchener's army are as follows: A medical officer is attached to each infantry battalion, one also to the cavalry and to each battery of artillery. From each battalion are drawn thirty-two trained men who retain their arms and can be otherwise used in an emergency, but it is their business to give "first aid" to the injured and convey them to the field hospitals, which will be at a convenient distance behind the brigades in some sheltered position. Behind each brigade are to be five field hospitals, each with one medical officer and accommodation for twenty-five men. These five field hospitals act as one, but are made sectional in order that the sections may be adapted to follow any battalion that may act independently of the brigade. With each brigade there is also a senior medical officer. From the field hospitals the wounded are to be conveyed for treatment, as soon as possible, to barges moored off the river bank, where there will be accommodations for 200 men. These barges are to be cleaned and disinfected and fitted up as hospitals. Other barges will be used for operating purposes. Two outfits of Roentgen ray apparatus are on the barges. Additional hospital facilities will be provided on the river banks. Between Khartoum and Atbara there were to be eight lines of communication hospitals, with fifty beds, each having a medical officer attached to it. At Atbara camp ample and special accommodations have been provided, the hospital has been built of mud bricks, with walls three feet thick, and the lofty roofs protect the men from the heat. The walls are sealed with matting and thickly thatched with straw, so that this hospital is probably as cool a place as there is in the Soudan, and here there is accommodation for 250 men.

The wounded reaching this hospital are provided with hospital clothing and bedding, having sheets for their beds. Six medical officers are in charge.

There is another hospital lower down the river at Abadeah. Fifteen miles north of Berber is another mud brick hospital, with accommodations for 300, and it is to have eight medical officers. From these places and from the Atbara camp trains specially fitted up for conveying the sick and wounded will be run. At Halfa and Assuan, where there are breaks between the rail and the river, there will be severally a fifty bed and a twenty-five bed hospital for the accommodation of the men who need rest after the journey. On each of the gunboats is a medical officer. Every kind of drug and instrument that may be required is plentifully supplied, and everything is of the best quality. The organization is so thorough that there is every reason to believe that in this war there will be no mismanagement whatever in the medical treatment of the British troops. There is a force of 20 medical officers, 149 non-commissioned officers and men, and 11 women nurses to take care of 500 patients. By successive lessons of experience the authorities have been schooled into forethought and attention to medical and sanitary details with results that are highly creditable to them.

In modern warfare with weapons of such great precision and long range the number of wounded is so enormous that it is beyond the means of the existing medical service of any army to deal with them at once, if the service is not largely increased, as in the present case. The surgeon of to-day, with all the modern appliances for the relief of the injured men, can do far more for the wounded than his predecessors in other wars could do, but this can be accomplished only by a radical increase in the number of surgeons who are sent with the army.

THE AMERICAN INSTITUTE PHOTOGRAPHIC, HORTICULTURAL, AND AGRICULTURAL EXHIBITION.

This exhibition opened on September 26, at the Academy of Design, this city, corner of Fourth Avenue and Twenty-third Street, and closes on October 8.

The photographic portion was got together by the secretary of the photographical section, J. W. Bartlett, M.D., and is a well arranged and interesting exhibit, comprising as it does beautiful prize genre photographs and novel effects in portraiture. The exhibit is confined to the north and east galleries and the corridor.

One exhibitor, Johannes Meyer, M.D., shows specimens of printing on silk and other fabrics by an improved process, and the Nepera Chemical Company in a special booth exhibits its quick printing process by gas light on what is called "Velox" paper. An exposure is made in the printing frame to a kerosene round flame light, about 6 inches distant, for 15 seconds, then the exposed sheet is removed from the frame at a short distance from this same light, placed in a developer and developed out by the aid of this light without damage in a very few minutes, giving an image of a rich black color or other color, as may be desired. The exhibition is more diversified and up to date than any the Institute has ever had, and is very instructive in showing the picturesque effects now obtainable by photographic apparatus and materials. About thirty-seven prizes were awarded by the judges —Charles I. Berg, William M. Murray, W. M. Hollinger, J. Carroll Beckwith, N.A., A. T. Bricher, A.N.A., and Edward Bierstadt.

The display of dahlias of all varieties and hues in the east room is very attractive. The west room is devoted to fruit and vegetable products, the center table holding examples of fruits exclusively, four-fifths of which is taken up in an exhibition of many varieties of grapes, including a few bunches of hothouse grapes of mammoth size. The south room contains large sized flowering plants of numerous kinds, and the corridor stairs, as one enters the gallery, is lined with exquisite delicate leaved ferns of many varieties. On the entrance floor were to be found several full sized models of garden implements, planters, plows, etc.

Altogether, the exhibition is unique in its way, combining as it does photography, flowers, and agriculture under one roof.

THE UNIFORM OF THE SOLDIER.

The returning regiments, clad in all kinds of costumes, have aroused considerable curiosity on the subject of uniforms in general. It is said that the Emperor Valerius Maximus ordered the Roman soldiers to wear red, so they would not be frightened at the sight of their own blood, and even now red forms a conspicuous part of the uniforms among the French and British forces. Red has been ruled out of our own army of recent years, except for facings, largely upon the theory that the color was too conspicuous to carry into the field. This is not, however, strictly true, if we rely upon experiments made by the European military experts. German rifle range practice has shown that a blue target is hit three times while a red target is hit once. Other interesting tests have been made with a view to determining the distance that soldiers are visible; and out of a squad of ten soldiers clad in gray, scarlet, dark blue, and green, dark gray was the color that remained longest in view; next came the dark blue with the dark gray, while scarlet was the second to disappear, being excelled only by the dark gray.

The evolution of the uniform is the subject of an interesting article in The New York Evening Post, from which we glean the following facts: When the Revolutionary war broke out, each colony had its militia, and the uniforms of no two bodies were alike. At Lexington and Concord it does not appear that the patriots had any uniforms. The same is true of Bunker Hill, but soon after the latter battle, some general rules for a military costume were adopted. The higher officers came to be known by the colors of the ribbons worn across their breasts. The officers lower in rank were distinguished by the cockades worn in their hats. Throughout the war there was no special system of uniform in force for the rank and file of the patriotic army, for obvious reasons; the colonists were poor, and the war made it impossible to import material for clothing from England. Homespun did not lend itself readily to great variations of color, and even after it had been decided to make blue the standard color of the American uniform, the local jealousies existing between the colonists required the use of different colors for facings. In 1802 a uniform was prescribed for our army consisting of a dark blue coat reaching to the knee, scarlet lapels and cuffs, white waistcoat and cross belt, and dark blue pantaloons for the winter and white for the summer. These articles of clothing were exchanged later for single-breasted coats without facings, and during the whole period the height of the collar kept rising, ending with the requirement that it should be worn high enough to reach the tip of the ear, and in front as high as the chin would permit in turning the head. It was in this costume, including a high silk hat, that our ancestors fought the British in the war of 1812. In 1821 dark blue was declared to be the national uniform color for both officers and enlisted men, the only exception being scarlet coats for musicians and gray coats for cadets. Various changes took place in the shape of the clothing of the soldiers until 1863, when our uniforms became practically fixed, the cloth for the trousers being light blue and the facings being light blue for infantry, yellow for cavalry, and red for artillery.

For general campaigning, the old Continental uniform, which was largely used during the Revolutionary days, is the most satisfactory. The British came to associate with this costume the idea of the skilled hunter and marksman, as found in our soldiers of that day, and they dreaded nothing more than coming upon a large body of colonists clad in this garb.

With the refinements of the uniform came a series of changes in the fashion of wearing the hair and beard. In the days of the Revolution, the troops, when on dress parade, wore their hair queued and powdered, and they themselves were clean shaven. One of Washington's orders was that at general inspection and reviews two pounds of flour and one and one-half pounds of rendered tallow for a hundred men should be used in dressing the hair, and another reminded the men that they would "not be allowed to appear with their hair down their backs and over their foreheads and down their chins at the side, which makes them appear more like wild beasts than soldiers," and that "any soldier who comes on the parade with beard or hair unkempt shall be dry shaved immediately and have his hair dressed on parade." It was not until a half century later that the order regarding whiskers was rescinded, the only rule since then being that they be kept short and neatly trimmed.

SAVING THE "MARIA TERESA."

The successful floating of the "Maria Teresa" has revived speculation in regard to the possibility of floating the "Colon." It is understood now that the government will afford Lieut. Hobson every facility for carrying forward this task. The difficulties in the way of raising the "Colon" are well understood, and any one examining the view of the "Colon" published in the SCIENTIFIC AMERICAN of July 30, as she lies on her side battered by the breakers, will appreciate the serious obstacles to be overcome.

The "Teresa" was blown off the rocks into deep water by dynamite on September 23, and proceeded to Guantanamo Bay accompanied by a wrecking tug, and she will shortly leave for a Northern navy yard, where she will be docked. Lieut. Hobson had charge of the raising of the "Teresa." His scheme for floating the "Colon" is most elaborate, and involves the use of air bags and dynamite. He has also suggested to the department the advisability of pulling the "Colon" around so that she will lie parallel to the shore instead of stem on. Reports received from Santiago show that the "Reina Mercedes" can be raised without any great trouble. She is sunk just at the mouth of Santiago Harbor, in a position well protected from storms, and when the work on the "Colon" is ended the wreckers will turn their attention to her. The "Mercedes" is a protected cruiser of 3,090 tons, and was built eleven years ago. The authorities consider her well worth saving. It is a curious fact that the Spanish officers of the "Mercedes" considered that, after the destruction of Cervera's fleet, the Americans would be caught napping, and that the "Mercedes" would have no trouble in forcing the blockade. The "Maria Teresa" will certainly form a great object of interest when she is refitted and when she appears flying the stars and stripes.

"SLATE WRITING AND KINDRED PHENOMENA."

It gives us great pleasure to announce that we commence in this number the publication of a series of articles under the heading given above. They are from the pen of Mr. W. E. Robinson, who is a well known authority on magic art, as he has been identified with it for the past twenty-five years. The articles are of particular value, as in his youth Mr. Robinson was brought up in the spiritualistic belief, but when he commenced to dabble in magic and understood the clever tricks of the prestidigitateur, the phenomena he often witnessed at séances became mere delusions and shams. He has made it a life study to deal with the methods employed by mediums to dupe their victims. Mr. Robinson has devised some of the cleverest stage illusions ever produced, and for many years was the assistant of the late Herrmann. He was also connected with the celebrated magician Kellar and is now stage machinist of the present Herrmann company. The articles will be profusely illustrated.

EXPLOSION OF A MOUNTAIN LOCOMOTIVE AT PRESCOTT, ARIZONA.

We have from time to time published engravings showing the effects of boiler explosions, and some of them have presented striking examples of the terrific disruptive energy that is pent up in a modern high pressure boiler. We do not remember, however, any of these catastrophes that equaled or even approached in its complete destructiveness the locomotive boiler explosion which forms the subject of the accompanying illustrations.

SHELL OF EXPLODED BOILER FOUND 1,200 FEET FROM ROUNDHOUSE.

We are indebted for the photographs and particulars to Mrs. C. L. Richards, of Prescott, Arizona, where the disaster occurred. Our correspondent was at the roundhouse (or rather the site of the roundhouse, the structure having been swept away) a few minutes after the explosion, and the two photographs show the exact disposition of the wreck before any attempt had been made to remove the debris.

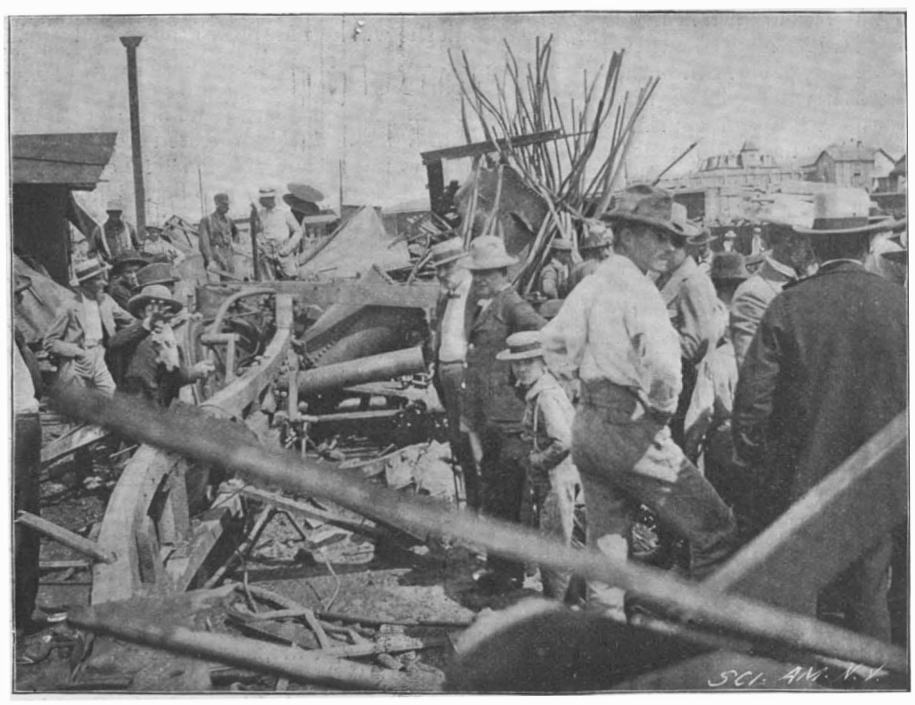
Prescott, Arizona, is a mountain town on the Santa Fé, Prescott, and Phœnix Railway, and the wrecked engine was a heavy "mountain locomotive," which weighed, exclusive of the tender, over 60 tons. At the moment of the explosion there were some fifteen or twenty men at work near the engine, and, remarkable to relate, although not only the engine but the roundhouse itself was blown to pieces, there were only three serious casualties. Two men were killed and one other who was passing at the time was badly injured, but will recover. As far as could be learned, everything on the locomotive was in a normal condition just before the explosion, and the cause of the disaster is a mystery to the company. The condition of the wreck, the extraordinary distances to which heavy fragments were hurled, suggests the work of some explosive of far greater energy than steam at ordinary boiler pressure. The testimony of one witness at the inquest to the effect that one of the men was at the time on the top of the boiler adjusting the pop valve is significant, and it may have been that a steam pressure far in excess of the 180 pounds ordinarily carried in modern locomotive boilers had accumulated through neglect or oversight. Indeed, it is scarcely conceivable that steam at ordinary pressure could have produced disruptive and shattering effects that would do credit to a heavy charge of dynamite.

Our correspondent, who was an eyewitness, says: "As I saw it, it appeared as though the whole engine was blown fully three hundred feet into the air, pieces large and small flying in every direction, and some of them landing half a mile and more from the wreck." The main force of the explosion was expended in a southerly direction, toward the town. The boiler shell was ruptured longitudinally on the under side from end to end, and was flattened out as shown in the photograph. The entire shell, with the steam chest attached, weighing several tons, described a magnificent curve through the air, rising to a height of about 300 yards and landing 1,200 feet away. On striking the ground it rebounded into the air, finally landing on a warehouse, and completely demolishing the front of the building. This effect and the appearance of the boiler shell are shown in the engraving. As it opened out under the force of the explosion, the shell literally tore the massive bar frame of the engine apart longitudinally, as will be seen from the cut of the engine wreck. The view is taken looking forward, and the left hand frame, badly twisted, with an axle and the left driving wheel attached, together with the leading truck, are about all that remains of the 60-ton engine. The explosion not only tore apart the transverse fastenings of the side frames, but it forced all the wheels off their axles; and when it is remembered that each of these is forced onto its axle under a pressure of from 50 to 80 tons, we have a further impressive evidence of the pent-up energy of a locomotive boiler.

In the immediate front of the illustration is seen a fragment of the foot plate still bolted down to the frame, and the left hand rocking shaft is also in place. The smoke box, with the front flue sheet and most of the tubes, is lying just ahead of the wreck, while the other remains of the locomotive are scattered around over a radius of thousands of feet, one piece of metal being found at Fort Whipple, over half a mile distant from the roundhouse.

The air pump, weighing 500 pounds, "was hurled with such force," according to our correspondent, "that it went whistling and shrieking through the air over the housetops, striking the ground, bounding fully 50 feet into the air, and finally landing near the post office, 2,500 feet from the wreck. The sound as it flew through the air was frightful and indescribable." Windows were shattered 1,500 feet away and the town was literally bombarded by fragments of iron which "went through roofs and sides of houses, making holes in walls and floors and breaking furniture." No one, fortunately, was struck, although "bolts, iron bars, crooked and twisted pipes, and pieces of brass and steel were strewn all over the town."

It would be interesting to learn just how far the "pop valve" adjustment, of which one witness seems to have spoken, was responsible for the disaster. The indications are that the ordinary boiler pressure must have been doubled, or even trebled, at the moment of explosion.



WRECK OF A 60-TON MOUNTAIN LOCOMOTIVE AT THE ROUNDHOUSE.

Volcanic Flames.

Although volcanic flames have been seen and described by many writers, their existence has been doubted by others. Special interest thus attaches to the outbursts of flame which occurred on Vesuvius in April last and which are dealt with in two papers — one by Prof. E. Semmola, in the Rendiconto of the Naples Academy, the other by Prof. V. Matteucci in the Atti dei Lincei. From the former paper it would appear that this rare phenomenon may have been caused by the falling in of a part of the crater wall, and consequent blockage of the orifice, the pent-up gases becoming heated until a chimney was formed through which they escaped in flames. Prof. Matteucci's paper concludes with the following summary of the principal points: 1. The greater part of the aeriform substances evolved from volcanic magma has the power of producing flames. 2. The small flames in the crater of Vesuvius were of longer duration than the large ones; these latter did not last without intermission for more than nineteen or less than fifteen days, and ultimately became small and quiescent like the others. 3. The complex phenomenon, of which the flames were one of the most interesting features, seems only comparable with that described by Sir Humphry Davy. It has not been reproduced or, at any rate, has not been noticed on Vesuvius for eighty-four years. 4. The spectrum produced by these flames is continuous, like that observed by Libbey in the incandescent lavas, also with flames, of Kilauea.—Nature.

AN IMPROVED STOCK-YARD GATE.

The illustration presented herewith represents a stock-yard gate so constructed that it may be quickly opened and closed and locked against live stock, or held partly raised whenever it is desired to separate small from large stock. The gate has been patented by Benjamin F. Strange, Corvallis, Mont.

The gate is hung by one corner on a transverse pivot carried by a post formed of uprights and mortised cross-bars, the construction being such as to permit the gate to swing between the uprights and the cross-bars. To the inclined top bar of the gate a rope is fastened that passes upwardly under a pulley journaled in the top cross-bar and through a bearing formed on a sliding latch normally resting on the top cross-bar. The upper end of the rope is provided with branches connected with levers in the manner indicated in the illustration. The latch is adapted to engage a shoulder on the upper end of the gate to hold the gate in locked position. Ropes connect the latches with the levers already mentioned, and hang down within reach of the hand. In opening the gate, one of these latch-ropes is pulled so as to raise the latch and disengage it from the shoulder on the gate. A further pull causes the lever to swing and act on the branched gate-rope so as to move the gate upwardly on its pivot. When it has passed a central position, the gate will swing down by its own weight to the open position shown by dotted lines in the engraving. In closing the gate, the operation is repeated, a pull on one of the ropes that hang down sufficing to bring the gate back to its initial position. When it is desired to separate small from large stock, then the gate is swung upwardly to a position partly open and locked in place by a bolt engaging a bearing in the free end of the gate.

STRANGE'S STOCK-YARD GATE.

Railways of Hawaii.

There are three railroads on the Hawaiian Islands, according to The Railway Review. The Kahului Railroad, on the island of Maui, is 13 miles long, and the Hawaiian Railroad, on the island of Hawaii, is about 20 miles long. These two roads are used principally to carry the products of the plantations to the various points of shipment. The principal road is the Oohu Railway and Land Company line, which runs from Honolulu to Waianae, the total length, including sidings, being 38·5 miles. This road was opened for traffic July 1, 1890, since which time its business has shown a steady increase, both in its passenger and freight traffic. Last year the road carried 85,596 passengers, receiving a revenue of $30,993.50; 66,430·49 tons of freight were carried, earning $69,752.76. The equipment consists of 5 locomotives, 14 passenger coaches, and 132 freight cars. The road is bonded for $2,000,000 at 6 per cent, with $700,000 worth of stock, which is to be increased to $1,500,000.

PHOSPHORUS is now produced by means of the electrical furnace. The method consists in heating a mixture of phosphate of lime and coke, which are first reduced to a powder. When the mass becomes pasty, the openings of the furnace are sealed except one, through which the vapor passes. The vapor is collected and distilled.

A NOVEL MAGAZINE CAMERA.

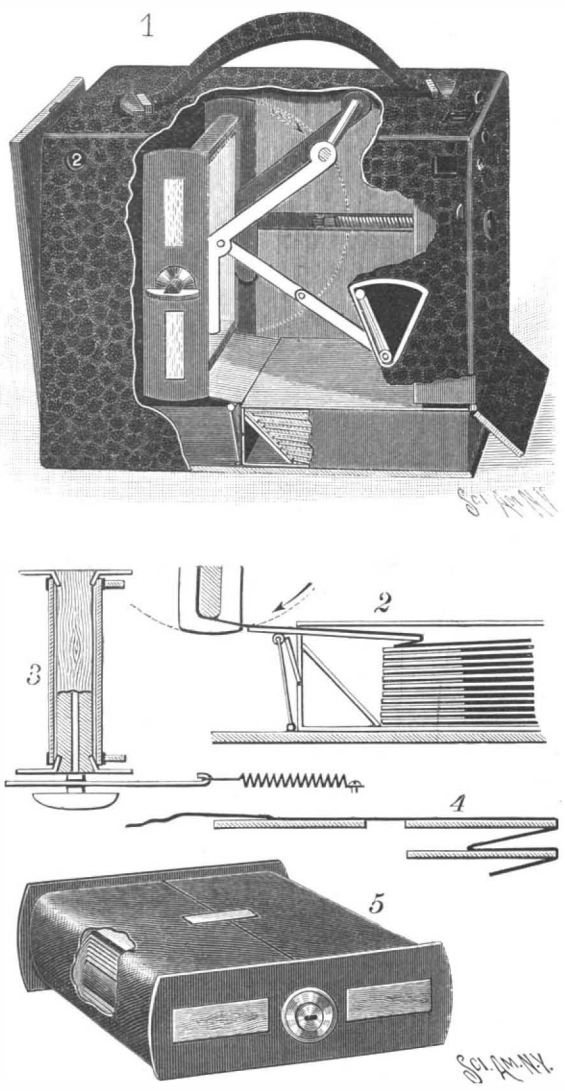
How to get the most out of the time at command is an important question in matters of recreation, as well as business. Some cling to old methods, and are satisfied with the way things were done years ago; but others find that by adopting improved methods and apparatus, more can be accomplished in a given time and in a more satisfactory way.

This applies to everything, but to nothing more pertinently than photography.

From slow plates and lenses and quick plates and magazine cameras; from roll holders and cameras to be loaded with films by daylight, we turn to an invention which allows the photographer to retain all the good qualities of glass plates and at the same time to secure the advantages of loading by daylight.

Messrs. Benjamin Marx and Henry Gassner, 2695 Third Avenue, New York, are the patentees of the camera to which reference is made, and which is shown in the engravings. Fig. 1 shows the camera with the side and top broken away to show internal construction and Figs. 2 to 5 inclusive show the details of construction.

The camera does not differ materially in external appearance from the usual form of hand camera. It has an objective and two finders. The glass plates used are placed in regular order on a long strip of tough paper, each being held in position by a mat which



MARX AND GASSNER'S MAGAZINE CAMERA.

barely covers the edge of the plate and is fastened to the paper.

The strip on which the plates are thus mounted is folded back and forth upon itself in a light-tight box, with the plates between the folds, as shown in Figs. 1 and 2. The side of the box is provided with an incline to facilitate removing the plate from the box. The box of mounted plates is sealed with the end of the paper strip projecting through a slit. The box is put in its place in the camera with the end of the strip projecting.

In the camera box is placed a flat reel provided with journals on which it can turn. The body of the reel is wood. It is made in two pieces, so that it can be folded together compactly. The metal heads of the reel are removable, thus permitting of carrying an extra reel in the camera. When it is desired to use more than two dozen plates, an extra reel may be carried in the pocket. An eyelet in the end of the paper strip is placed on a hook on the reel, and after the end of the camera is closed the reel is turned, thus bringing a plate from the box and folding it down on the face of the reel.

The journals of the reels are pulled forward by springs, as shown in Fig. 3, and when the plate is brought into an approximately vertical position, a pair of angled levers secured to a rock shaft are brought into contact with the plate, causing the plate to stand in the focal plane, the springs which draw the reel forward yielding as the angled levers are brought into position. This operation also locks the angled levers by means of the toggle joint connected therewith.

After the exposure is made, another plate may be brought into position for exposure by releasing the reel and turning it through a half revolution. The operation of focusing the plate and locking the reel is the same as before.

When all of the plates have been exposed, the blank paper contained in the plate box is wrapped around the exposed plates by turning the reel, and, with the reel heads, makes a light-tight package which is removed from the camera and sealed as shown in Fig. 5.

The empty plate box is removed and replaced by a full one, another reel is placed in the camera, and the operation just described is repeated.

It will thus be seen that there is practically no limit to the number of plates that can be exposed in this camera.

It can be loaded in broad daylight. It exposes a dozen or more plates at one loading, and is lighter than other cameras of the same capacity using plates.

SPIRIT SLATE WRITING AND KINDRED PHENOMENA.—I.

BY W. E. ROBINSON.

There has probably been nothing that has made more converts to spiritualism than the much talked of "Slate Writing Test," and if we are to believe some of the stories told of the writings mysteriously obtained on slates, under what is known as "severe test conditions" that preclude, beyond any possible doubt, any form of deception or trickery, one would think that the day of miracles had certainly returned; but we must not believe half we hear nor all that we see, for the chances are that just as you are about to attribute some unaccountable spirit phenomena to an unseen power, something turns up to show that you have been tricked by a clever device which is absurd in its simplicity.

There are a large number of methods of producing slate writing, but the writer will describe a few which will be sufficient to give an idea of the working of slate tests in general. First we have the ordinary one in which the writing is placed on the slate beforehand, and then hidden from view by a flap or loose piece of slate. (Fig. 1.) After both sides of the slate have been cleaned, the false flap is dropped onto the table, the side which is then uppermost being covered with cloth similar to the table top, where it will remain unnoticed, or the flap is allowed to fall into a second slate with which the first is covered. In the latter case no cloth is pasted on the flap. Sometimes the flap is covered with a piece of newspaper and is allowed to drop into a newspaper lying on the table, then the newspaper containing the flap is carelessly removed, thus doing away with any trace of trickery.

Another way of utilizing the false flap is as follows: The writing is not placed beforehand on the slate, but on the flap, which, as before, is covered the same as the table top. This is lying on the table writing downward. The slate is handed around for inspection, and, on being returned to the performer, he stands at the table and cleans the slate on one side, then turns it over and cleans the other. As he does so he lifts the flap into the slate. The flap is held in firmly by an edging of thin pure sheet rubber cemented on the flap between the slate and the cloth covering of the slate. This grips the wooden sides of the frame hard enough to prevent the false piece from tumbling out accidentally.

We now come to another style, wherein a slate is cleaned on both sides, and, while held in the hand facing the audience, becomes suddenly covered with writing, and the slate is immediately given for inspection. The writing is on the slate previous to the cleaning, and is hidden from view by a flap of slate colored silk, held firmly in place by a pellet of wax in each of the corners of the silk. (Fig. 2.) Attached to this silk flap or covering (at the end that is nearest to the performer's sleeve) is a stout cord or string, which is also made fast to a strap around the wrist of the hand opposite to that holding the slate. If the arms are now extended their full length, the piece of silk covering will leave the slate and pass rapidly up the sleeve out of the way, and thus leave the writing exposed to view; and the slate is found to be still a little damp from the cleaning with the sponge and water it had been given previously. This is easily accounted for. The water from the sponge penetrates just enough through the cloth to dampen the slate.

There is still another slate on which we can make the writing appear suddenly. It is composed of a wooden frame, such as all wooden-edged slates have, but the slate itself is a sham. It is a piece of cloth painted with a kind of paint known as liquid slating, which, when dry and hard, is for all the world like the real article. This cloth is twice the length of the slate and just the exact width. The two ends of the cloth are united with cement, so as to make an endless piece or loop. There is a small rod or roller in both the top and bottom pieces of the frame, the ends being made hollow to receive them. Over these rollers runs the cloth, stretched firmly and tightly. Just where the cloth is joined or cemented is a little black button or stud of hard rubber or leather. This allows the cloth to be pushed up and down, bringing the back to the front; and by doing so quickly, the writing which is written on the cloth at the rear of the frame is made to come to the front in plain view. (Fig. 3.)

Still another idea in a single slate is as follows: An ordinary looking slate is given for examination, and, on

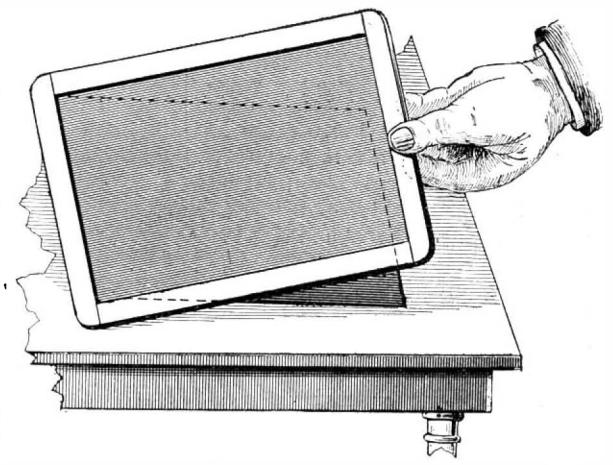


Fig. 1.—ORDINARY SLATE WITH FLAP.

its being returned to the medium, he takes his handkerchief and cleans or brushes both sides of the slate with it; and, upon again showing that side of the slate first cleaned, it is found covered with writing apparently done with chalk. The following is the simple explanation of it: Take a small camel's hair brush and dip it in urine or onion juice, and with it write or trace on the slate whatever you desire, and when it becomes dry, or nearly so, the slate can be given for examination without fear of detection. The handkerchief the performer uses to clean the slate with is lightly sprinkled with powdered chalk. He makes believe to clean the one side devoid of preparation, but the side containing the invisible writing is gently rubbed with the handkerchief, not too hard, just enough to let the powdered chalk fall on the urine or onion juice, where it leaves a mark not unlike a chalk mark.

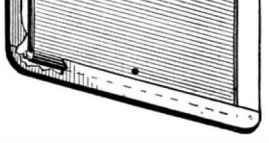


Fig. 3.—THE ENDLESS BAND SILICATE TRICK SLATE.

Casualties in the Army.

Adjutant-General Corbin has prepared a list showing the total number of officers and men who were either killed or wounded during the Santiago campaign. On June 30 the American army in Cuba consisted of 852 officers and 17,358 enlisted men. Of this number 23 officers and 222 men were killed and 92 officers and 1,285 men wounded. According to the official records the Santiago campaign only extended from July 1 to July 17, and this list does not include any of the casualties which occurred after the latter date.

Fig. 2.—REMOVING THE SILK FROM THE FACE OF THE SLATE.

Miscellaneous Notes and Receipts.

To Protect Reservoirs from Rust.—The Deutsche Färber Zeitung recommends to clean the tanks from rust and paint by means of a steel wire brush, to heat piece by piece by the use of a soldering lamp, and to rub down the heated portions carefully with shoemakers' wax. The wax enters all the pores and gives a protective covering which lasts for years, if the work is carefully done.

Solder for Glass.—A metallic compound which firmly adheres to glass, and can, therefore, be employed as a solder for glass, is obtained by melting together 95 per cent (by weight) of tin and 5 parts of zinc. The melting point lies at about 200° (C.?) By means of the soldering iron it can be spread upon the glass, previously heated to this temperature, and, after cooling, adheres firmly to it. An alloy of 9 parts tin and 1 part aluminum may be used for the same purpose, but has the drawback that its fusing point lies considerably higher, viz., around 390°.—Gold und Silberwaren Industrie.

Silver Affected by Sunlight.—Erdmann reports, in the Zeitschrift fuer Naturwissenschaften, that some tetradrachm pieces from about the year 500 before our era had experienced peculiar changes by the action of the sunlight. However strange it may appear that silver coins should be affected by the influence of light, yet chemical research has proved the correctness of the above statement. The analysis showed that the upper layer of the coins consisted of silver chloride, which probably had formed by their lying for centuries in sea water or in earth containing salt. Silver chloride, which, as regards its silver value, corresponds to an alloy of 75 per cent of silver and 25 per cent of copper, has, by the way, already been used for coining silver pieces, e. g., in the sixteenth century, at Freiberg, in Saxony, where rich finds of silver chloride had been made at that time. It had, therefore, to be decided whether the Greek coins in question might not have been coined directly from silver chloride. This supposition, however, was found to be wrong, as the silver chloride layer only constituted one-half gramme, below it very pure silver containing but slight traces of copper being met with.

Forgings of Aluminum Bronze.—Aluminum bronze is an alloy of 90 to 95 per cent of aluminum and 5 to 10 per cent of copper, of golden color, which keeps well in the air, without soon becoming dull and changing the color, like pure copper and its alloys with tin and zinc (bronze, brass). It can be cast excellently, can be filed well and turned, possesses an extraordinary hardness and firmness, and attains a high degree of polish; it is malleable and forgable. On the latter qualities are founded applications which were originally never thought of, viz., forged works of art for decorative purposes. An alloy of 95 parts aluminum and 5 parts copper is used here. The technical working of bronze is not materially different from that of iron. The metal is, especially in a warm condition, worked like iron on the anvil, with hammer and chisel, only that the temperature to be maintained in forging lies between dark and light cherry red. If the bronze could also be welded like iron, the artist forger would indeed have an ideal material, but that is not possible. If the articles are not forged in one piece, and the putting together of separate parts becomes necessary, riveting, and, above all, soldering, has to be resorted to, which can be done with soft or hard solder. Besides forging, the bronze is well suited for embossing, which is not surprising, considering the high percentage of copper. After finishing the pieces, the metal can be toned in manifold ways by treatment with acid.—Journal der Goldschmiedekunst.

Automatic Photograph Apparatus.—At the expense of Prince Albert of Monaco, L. Cailletet has invented two devices which have been used for the first time with the international balloon ascensions and have given great satisfaction. The first is a photographic apparatus which, every four and one-half minutes, takes a picture of the earth as well as of the upper regions automatically. Of the upper clouds very handsome pictures were obtained on which the numerals of the barometer could be distinctly read. This renders it possible, although the balloon be destroyed, to determine the height reached. In the same manner all other occurrences during the aerial trip are photographed and taken cognizance of. The Paris unmanned balloon has brought back 23 photograms, which show that the air ship after 36 minutes reached a height of 13,700 meters, while the temperature was 65° below zero; it is also known that it began to sink after a distance of 420 kilometers was covered. Such an apparatus can of course be taken along anywhere, and handsome views can be brought back from trips and excursions by any one not familiar with the art of photography. For tourists and wheelmen a new sport is opened thereby.

The second invention is an apparatus which collects air samples from the highest regions. On account of its weight, however, it could not be suspended from the unmanned balloon, but was taken along by the manned one and brought back air from an altitude of 2,800 meters, which is of great importance for the study of the character of the air at great heights.—Staats Zeitung.

Cost of Good Roads and Loss from Bad Roads.

In a paper read before the Engineers' Club of Philadelphia, recently, General Roy Stone, director of the Office of Road Inquiry in the United States Department of Agriculture, discussed "Various Phases of the Road Question," says Municipal Engineering. From data obtained from over ten thousand letters of inquiry sent out from his office, General Stone deduced certain figures, referring to the average length of haul from the farms to market or shipping points, the average weight of load hauled and the average cost per ton for the whole length of the haul. The figures, tabulated, are as follows:

Group of States.	Average haul, miles.	Average weight, pounds.	Average cost per 2,000 pounds per mile.	Total average cost per ton for whole length of haul.
Eastern	5·9	2,216	$0.32	$1.89
Northern	6·9	....	.27	1.86
Middle	8·8	....	*.31	*2.72
Cotton	12·6	1,397	.25	3.05
Prairie	8·8	2,409	.22	1.94
Pac. Cost. and Mtn.	23·3	2,197	.22	5.13
Whole United States	12·8	2,002	.25	3.02

* Middle Southern States.

Assuming the correctness of the data, and using the census return of farm products and forest and mineral outputs, and estimating incidental traffic, General Stone arrives at a total of 313,349,227 tons as representing the total annual movement over country roads. At the average cost, $3.02 per ton, the grand annual cost of haulage on public roads amounts to $946,414,665. Not including the loss of perishable products for want of access to market when prices are good, and the uselessness of cultivating certain products which depend upon the markets being always accessible, statistics of the cost of operating foreign highways, and the data obtained from the use of the few good roads existing in this country, would indicate that nearly two-thirds of the above cost is directly chargeable to bad roads. The enforced idleness of men and horses during a large part of the year is another item which should be charged largely to bad roads. The negative or hostile attitude of the rural population toward all effective legislation in this direction is an obstacle also to road improvements in this country, while another is the general overestimate of the cost of such improvement.

A few years ago the macadam roads of New Jersey cost $10,000 per mile; now equally good roads are being built for $3,000, even where railway transportation of material is required; and in localities better supplied with road material, and where a narrower road is deemed sufficient, $1,500, or even less, will make a mile of good stone road. Experience has demonstrated the fact that in most country districts a single stone road, 8 or 10 feet wide, with a good earth road on one or both sides, is more generally satisfactory than a wider road of macadam.

The discussion which followed brought up the question of steel for highway construction, and in answer to questions General Stone said the road proposed by the Department of Agriculture was to be made of longitudinal stringers, with about 8 inches of level surface, with a 3-inch flange to hold the ballast and a ½ × ¾ inch bead on the inside of the stringer to assist wheels in keeping on the track. These stringers would rest on broken stone or gravel in a trench provided, and be tied together at intervals by rods. About 100 tons of steel per mile of single track would be required, and he estimated the cost at about $8,500 per mile, at present prices for material. As yet the demand has not been sufficient to warrant the expense of preparing rolls for these special rails, or stringers. But experiments on short lengths had been made with the lightest kind of channel iron, and with plates and angles, and the results had been very satisfactory in the decreased tractive power required and in the ability to resist wear and displacement.

Forestry Preservation in the Schools.

Persons interested in forestry preservation in the United States are familiar with the name of Dr. B. E. Fernow, formerly the very efficient chief of the Forestry Division of the Department of Agriculture, and at present director of the recently established New York State College of Forestry at Cornell University. Dr. Fernow was one of the speakers at the recent meeting of the American Association for the Advancement of Science at Boston, and his address, which was in form a statement of the aims and organization of the institution of which he is director, attracted attention because of the practical bearing of many of his remarks on the general problems of forestry preservation, says Bradstreet's. Dr. Fernow said that the establishment of the college in the semicentennial year of the American Association marked a greater progress in the science and art of forestry than could be shown in any other direction during the existence of the association, for the reason that it meant the establishment of a professional center for an art which was not even known by name in this country when the association first met. It was also, he said, worth noting that just twenty-five years ago the first organized effort to establish the science of forestry preservation in the United States took shape in Section I of the association, whose council formulated a memorial to Congress, which the association indorsed, and which led to the establishment of the Division of Forestry in the United States Department of Agriculture, which became at once the center of the movement to secure recognition for this unknown science.

The movement culminated this year in the creation of a high-grade establishment, where the principles and methods of forestry may be professionally studied, the first of its kind in the United States. The establishment of the college, Dr. Fernow said, is a logical sequence to the policy to which the State of New York has been committed since 1885, with regard to the forests in the Adirondack Mountains—a policy under which the State has acquired over 1,000,000 acres of forest land, to be gradually increased to 3,000,000 acres. In the spring of the present year the New York Legislature passed an act providing for the State College of Forestry, and for the purchase of a demonstration area in the Adirondacks, placing both under the trustees of Cornell University, thus withdrawing the enterprise from any baneful influence of politics. In placing this college at a university instead of establishing a separate school, Dr. Fernow said, the most advanced ideas of forestry education in Germany, where it is best developed, have been realized. After an enumeration of the courses given in the college, Prof. Fernow described the proposed management of the demonstration school forest, which is to consist of 30,000 acres in the Adirondacks. Forestry, he said, has not for its ground maxim, as seems popularly to be believed, "Woodman, spare that tree," but "Woodman, cut those trees judiciously." The handling of a slowly maturing crop like forest trees requires an especial consideration of the problem which is quite unlike any other that presents itself to the business man. The trees ripen slowly, a full century being oftentimes necessary for the full development of growth. Obviously, therefore, it would be inadvisable to cut down the product and then wait for a hundred years for further income from the land; but another system is necessary, whereby the interest is taken merely in trees which are in condition to be cut, while the great principal, the forest itself, always remains practically intact. With such an experienced and capable director at its head, the new College of Forestry should do a kind of service not hitherto done for the promotion of forestry preservation, and attract more or less continuously a degree of attention to the subject hitherto only evinced at comparatively rare intervals.

The Effect of Anger on the Eyes of Animals.

"Until comparatively lately," says Louis Robinson, writing on "Eye Language," "there seems to have been a good deal of difference of opinion as to the action of the pupil under the influence of emotion. About five years ago I had some correspondence with Sir S. Wilkes, the distinguished president of the Royal College of Physicians, upon this very subject, and he informed me that after long inquiry he had been unable to get any trustworthy information as to how the pupil behaved in the lower animals when they were under the influence of emotion. The correspondence had been called forth by my stating in an article . . . that a dog's pupils dilate when he is angry.

"The evidence upon which I based this statement was gathered at the house of a friend who had a fox terrier which used to become furious when teased. It had a basket in the corner of the room to which it retired when offended. The light from the chandelier shone full upon its face, and I frequently observed that when the animal was especially angry, the eye chambers reflected the light in the same way as do those of a human being when the pupils are dilated with atropin. Having no quarrel with the animal myself, I could approach him with safety when others were exciting his wrath, and found that on such occasions the pupils of his eyes were widely open.

"It so happened that about the same time Sir S. Wilkes had been making observations upon parrots, and found that the pupil contracted when the birds were under the influence of anger. On extending my observations to other animals, I found that cats and monkeys exhibited the same peculiarity as the dog when enraged and meditating mischief, but that in several instances, as soon as the creatures were provoked beyond endurance and flew at their persecutors, the pupils suddenly contracted. I offer the following conjecture as to the reason of this phenomenon: When an animal is angry and face to face with a foe, but has not made up its mind as to the most effective method of attack, it is important that the eyes should take in as much as possible of the enemy and his surroundings; but when the actual onslaught is made, the attention of the assailant is fully concentrated upon some particular point of his adversary's body."—The Humanitarian.

Correspondence.

THE MAGNETIC NEEDLE.

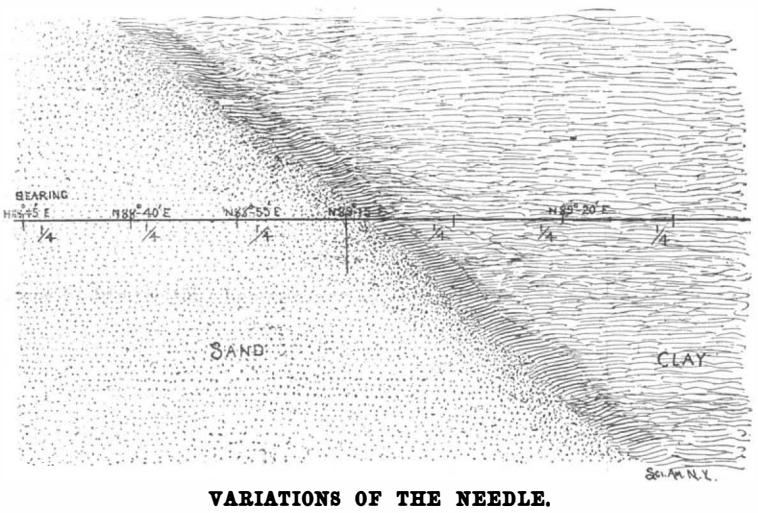
To the Editor of the SCIENTIFIC AMERICAN:

In running a line east and west recently, I ran from off a high table composed of sand to a low plain composed of clay. The sand was warm, the clay cold. The variation of the compass was different on the plain from that on the table land, being in a direction that would indicate that the two kinds of soil formed a thermal magnet, or, rather, that currents of electricity were formed, running from one to the other at right angles to the line of division, which was northwest and southeast. This is the second time I have noticed the same effect on needle of two soils of different temperature marked by a well defined line of division, and in each case it was the same, viz., there was apparently an electric current established, running at right angles to the line of division, and the needle had a tendency to vary in a direction which would bring it at right angles to this line of current.

This has led me to wonder if, after all the scientific research, the matter of the magnetic needle is not a little more simple than supposed, and that the two oceans and the two continents do not form electric currents running at right angles to their general line of division, to which the magnetic needle, as is natural, turns at right angles, and if the lines of no variation are not the points at which the centers of electric force are due east and west of each other.

The oceans retain their coolness almost completely, and the continents their warmer temperature, thus making the different temperatures for the forming of two large thermo-magnets. I have not made a study of this, but the idea merely struck me, and it would be in accord with everything, so far as I can see, and explain many things, such as line of no variation and diurnal and seasonal changes of variation, which do not seem easily accounted for. If this theory is plausible from a scientific standpoint, from the light thrown on it by other scientific truths that I know anything of, I wish you would put it into discussion. Herewith find a diagram of the point referred to.

L. S. C.



VARIATIONS OF THE NEEDLE.

The Acetylene Gas Hazard.

To the Editor of the SCIENTIFIC AMERICAN:

It is but perfectly natural that after such explosions and casualties, resulting in loss of life and property, which have occurred from time to time in the manufacture and subsequent manipulation of acetylene gas, both in this country and abroad, that the insurance companies and the public at large should be a little anxious to establish some fixed form of regulation which will insure safety to all concerned in future operations on this line.

It is, however, to be deplored that at the present stage of investigation of the manufacture and use of acetylene, the proposed legislation should be so strenuous and at the same time impose impossible conditions, as is set forth in the set of rules approved by the National Board of Fire Underwriters, at its recent annual meeting.

It has been conclusively proved that in no single instance have any of these explosions taken place at the hands of other than so-called experts; and, moreover, these explosions have all been the results of work conducted on experimental basis; and, in all but one instance (explosion at Wilmington, Del.), these disasters have taken place as the result of attempts to liquefy the gas and to control it under pressure; and in each and every case said disasters have taken place solely through either carelessness or gross ignorance on the part of the operators. Of course, as is well known, acetylene will combine with air in certain proportions to form mixtures which are extremely explosive under certain conditions, but even these mixtures, when intelligently handled, are not dangerous, and in properly constructed apparatus explosions cannot occur.

The most dangerous form of acetylene is its liquid state, when it requires a pressure of 600 pounds per square inch to keep it in its normal condition. These points were very strongly brought out at the investigation following the explosion in Jersey City, December 4, 1897, as published in The Progressive Age of May 2, 1898.

As per Dr. Henry Morton's testimony at the above mentioned inquiry, acetylene in its native and quiescent state is no more dangerous than our ordinary illuminating gas, which, indeed, contains a certain amount of acetylene.

Some of the most distinguished and expert chemists of all time have experimented with this gas, and such men as Berthelot, Le Chatelier, Moissan, and Pictet have all arrived at the same conclusion, and this independent of each other, that gaseous acetylene at atmospheric pressure is absolutely harmless as regards spontaneous decomposition and subsequent explosion.

The dangerous qualities are not developed in the slightest particular until the gas is compressed or liquefied, in which condition, when subjected to a rise in temperature, it becomes an exceedingly dangerous compound, owing to its great liability to decompose.

As regards the wholesale generation and liquefaction of acetylene, strong measures should be taken to bring these operations within the safety limit, and the proposed legislation on this point should by all means be adopted.

In such small amounts of acetylene as are generated in a bicycle lamp, or, in fact, in any lamp having a portable generator and operating at atmospheric pressure, no dangerous conditions can, under any circumstances, occur.

Regarding the paragraph in the proposed insurance regulations which relates to the construction of a lamp, it is sufficient to state that it is an utter impossibility to so construct a portable generator that it will not disengage gas for some little time after the water has been turned off. Any lamp that has been constructed with this principle in view would be absolutely worthless as a continual light giver, and at the same time would become a dangerous instrument.

The proviso is, in my opinion, ridiculous in its entirety, and, if enforced, would practically mean the complete prohibition of the manufacture of all kinds of portable generator lamps.

Regarding the regulation restricting the material of which the lamps should be constructed, there seems to be a misunderstanding among scientists on this point.

It is asserted by many experimenters that acetylene, upon coming in contact with metallic copper, will form a compound which is highly explosive when heated or struck; while, on the other hand, there are an equal number who claim the contrary.

The result of my experiments in this direction are as follows: A copper tube 4 feet in length, 4 inches in diameter, was thoroughly pickled and cleaned. This tube was filled with the gas taken direct from a generator without being cleaned or purified in any manner, and the tube was then hermetically sealed and allowed to lie on its side for two months. It was then opened, and the compound formed was scraped off and dried and then tested for explosibility, with the result that it was found to be perfectly harmless.

My second experiment was to pass the gas through, first, water, then through a lead salt solution, thence through a quantity of calcic chloride, in order to dry it, and then through a saturated ammonia solution of cuprous chloride. When free acetylene was observed to be issuing from the escape tube of the last bottle, the experiment was taken to be concluded; the precipitate formed was then filtered and dried at 100° F. This compound was found to be extremely explosive when confined.

From these experiments I draw the following conclusions:

First. Acetylene in contact with a metallic surface of either pure copper or of any alloy containing copper does form a compound which is not explosive or at all dangerous.

Second. When acetylene gas, in a free state, is brought in contact with copper held in solution in an alkaline form, a chemical reaction takes place, whereby the true acetylide of copper is formed, which is explosive in a dry form when confined; or, in other words, there must be opportunity for cuprous oxide to form before we can have the acetylide.

Third. That the compound formed in experiment No. 1 is different in its physical deportment from that formed in experiment No. 2, and although it appears to have the same chemical construction, it really is not the acetylide of copper.

Regarding the last paragraph of the recommendations, "It is also recommended that the generator be so designed that it can be supplied with calcium carbide, and the residuum withdrawn without the escape of gas or the admission of air, in order to insure the prevention of dangerous explosive admixtures of air with the gas in the generator," it is not at all clear in my mind how such an arrangement can be designed without making a complicated and expensive form of generator.

L. J. KROM.

Waterbury, Conn.

Mistake of a Mud Wasp.

To the Editor of the SCIENTIFIC AMERICAN:

It is generally supposed that instinct unerringly teaches birds and insects the best way in which to build their homes or nests, and also to provide for their offspring. The following incident, recently under personal observation, will show that instinct is not always infallible.

A friend placed three small empty vials in an open box, on a shelf, in an upright position in close contact, and they were uncorked. A short time afterward it was a matter of surprise to find that these had been appropriated by a female mud wasp. She had placed a goodly number of spiders in the center vial, doubtless intended to serve as food for her future brood; then proceeded to deposit her eggs in those on either side. She next closed tightly the mouths of all three receptacles with a hard lime cement. Having finished her work, she then doubtless went on her way, satisfied all had been done for her offspring that a thoughtful mother could do.

But just think of the sensations of those little wasps when they come into existence, for, while starving in their sealed cages, they can plainly see, through the impenetrable glass walls, the bountiful supply of food which was provided for their use.

Rodney, Miss. F. W. COLEMAN.

Old Papyri at the Chicago University.

Chicago has come into the possession within the last few weeks of what promises to be the most valuable collection of ancient writings ever on this side of the Atlantic Ocean. Through the efforts of Edgar J. Goodspeed, of the Chicago University, son of the secretary of the institution, it has secured the latest and most promising find of manuscripts made in Egypt in years. In the neighborhood of two or three hundred complete pieces of papyri, in a good state of preservation, are included in the collection, besides hundreds of fragments. This collection of manuscripts, of which such interesting things are expected, was found by an old Arab sheik while digging about in the sands somewhere along the bank of the Nile. It is supposed by the two or three scholars who have already glanced at this collection of papyri that they were found in the neighborhood of what was once the city of Asioot or Asiut. They were written in Greek during or before the time of the Roman occupation of Egypt, and some few of them, partially deciphered, show a date approximating 160 A. D., or during the reign of Emperor Hadrian. But there are many others not yet investigated which are evidently of a much older writing, and give promise of some most interesting results. Among them is a fragment of Homer of great value, and the chances of finding another scrap of the New Testament of a similar nature to that recently discovered in Egypt are thought bright.

The manuscripts are found to be principally commercial documents of Hadrian's time, with a few pieces of a literary nature. In the days in which they were written the Romans farmed out the collection of taxes, intrusting the work to various contractors. The receipts and statements which the latter made in their accountings with the government officials compose the bulk of the smaller fragments. They are interspersed with business letters and memoranda of a commercial nature. Frequently scraps of large manuscripts have been taken and used for hasty figuring and notes of transactions. Several months, possibly years, will be needed to complete the work of translating the whole of the papyri. Each of the larger pieces of papyri will be preserved between sheets of glass, and then carefully translated.

Physiological Signification of Eating Salt.

Some diversity of opinion has existed among physiologists as to the physiological signification of eating salt. According to Bunge, the use of sodium chloride with food is to counteract the effects of the potassium salts predominating, especially in vegetable diet, while other physiologists regard salt purely in the nature of a condiment with no special action. M. Léon Fredericq, writing in the Bulletin de l'Académie Royale de Belgique, describes his observations on certain salts used by the natives of the Congo State. These salts are produced by the incineration of aquatic plants, and are placed on the market in the form of cakes produced by evaporation of the solution formed by dissolving the residue. An analysis shows them to consist almost entirely of chloride and sulphate of potassium, the former largely preponderating, and the presence of sodium being only detectable by the spectroscope. The fact that salts of potassium are thus used for cooking purposes seems to negative the views of Bunge, and to support the opinion, previously advanced by Lapicque, that the use of salt is primarily to improve the flavor of food.

CONSTRUCTION AND DETAILS OF THE KNAPP ROLLER BOAT.

In our issue of October 30 of last year we commented editorially upon the Knapp roller boat and pointed out what seemed to us to be the difficulties in the way of such a boat attaining the results anticipated by the inventor. On December 18 we published a letter from Mr. R. C. Rayson, a friend of Mr. Knapp, in which the theories upon which the boat was built were set forth.

The facts to which we drew attention were, first, that if the boat were to run at any considerable speed, the water would be carried up by skin friction on the rear half of the cylinder and act as a brake to check the rotation; and, secondly, that the great area presented by the cylinder would render it impossible to propel it in the face of a gale of wind. Mr. Rayson's letter, to which the reader is referred, is indorsed by Mr. Knapp, whose letter is quoted below. From the two letters and the accompanying photograph it is possible to have a clear idea of the points of difference between the Knapp boat and that of Mr. Bazin and the ordinary type of boat as represented by the "St. Louis" or the "Lucania." It is claimed that, as the disk-shaped wheels of the Bazin boat and the wedge-shaped hull of the "St. Louis" are both deeply immersed, they progress through the water by displacing it to the right and left, and that, as the speed increases, the resistance of the water to displacement increases at a rapidly multiplying ratio, or as the cube of the speed. On the other hand, the designer of the cylindrical form of roller boat expects that at high speeds the resistance of the water to displacement will be so great that the boat will tend to climb to the surface and travel with practically no immersion, being sustained in somewhat the same way as a flat pebble that skims over the surface of a pond, the first moving with a rolling and the latter with a sliding contact. We pointed out at the time that, although the cylinder, if propelled at sufficient speed over still water, might tend to climb to the surface, just as a 30-knot torpedo boat will lift several feet of her forefoot above the water at her highest speed, it could only be done at the cost of great power; since it would not merely be necessary to raise the 100 tons weight of the cylinder some two or three feet (the draught of the vessel), but power must be absorbed in maintaining it at that level.

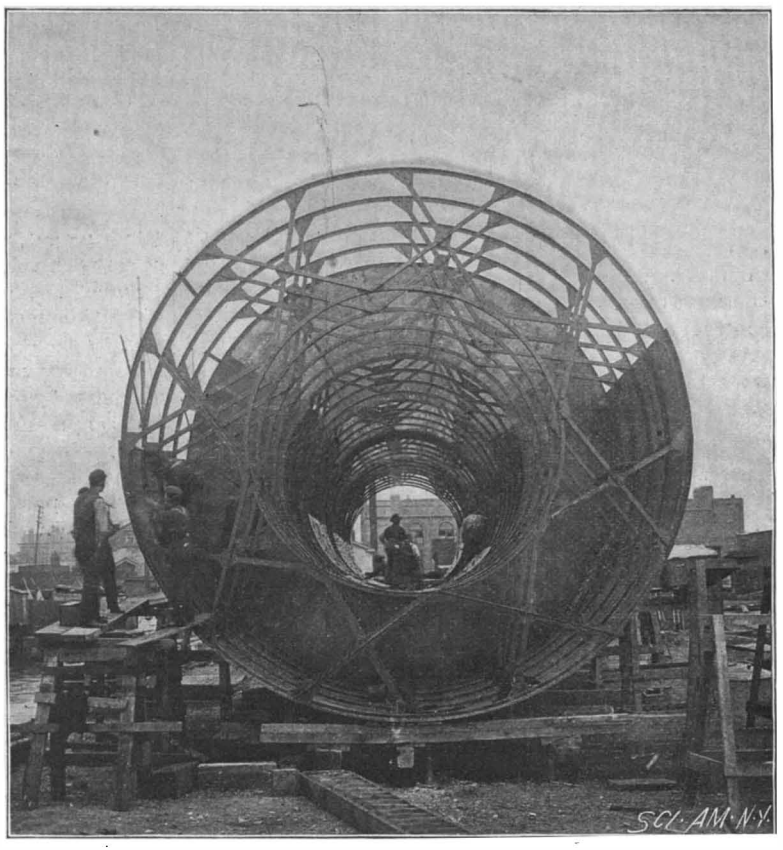
Mr. Knapp, however, does not believe this, and we give his statement of the case in his own words:

"If you cannot displace more water with a body than it weighs, how can my boat possibly displace any water when it meets a resistance greater than its weight, taken broadside on, to get the greatest possible resistance? It is this resistance which brings the boat to the surface, and if you maintain or increase the speed, how in the world can it sink again until the speed is decreased, thereby lessening the resistance or support? It is not the power which holds it up, but the water, which becomes a 'granolithic pavement,' so to speak."

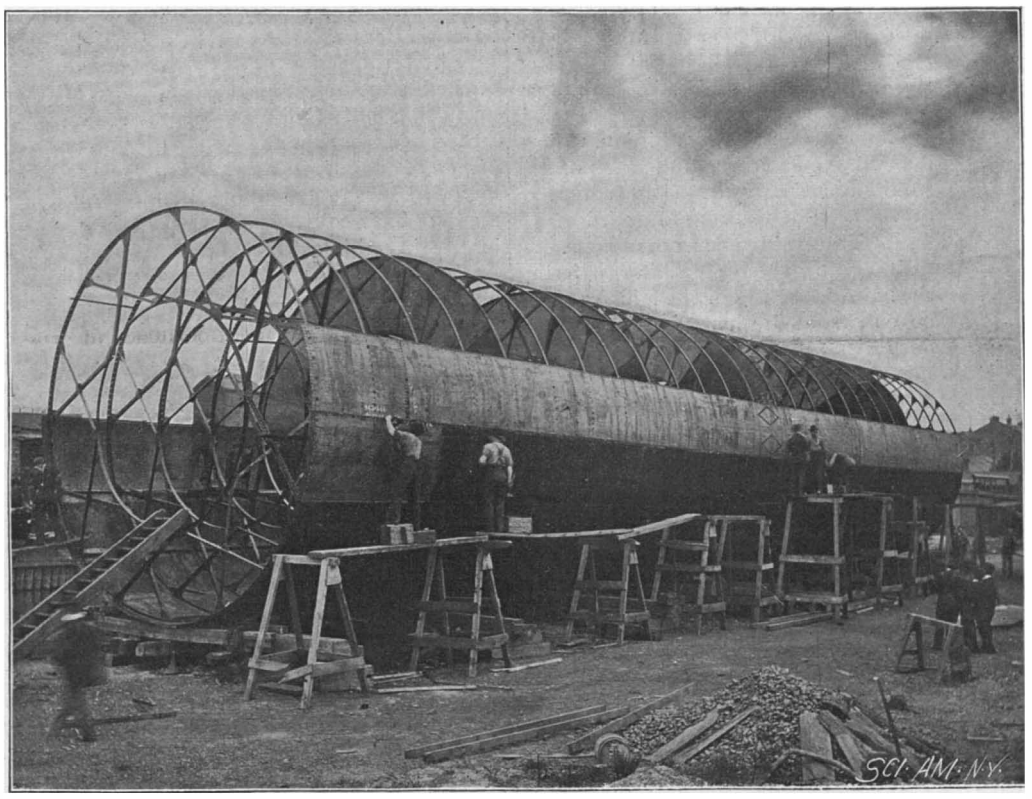
Mr. Knapp has recently favored us with the accompanying photographs, showing the construction of his boat, and with some particulars of the first trials and of a second boat that he is building, which we think will prove of interest to the readers of the SCIENTIFIC AMERICAN. It will be seen that the hull is formed of an outer and inner shell laid upon circular frames. There are twenty-six frames, spaced about 5 feet apart. They are built of angle iron, and each inner and outer frame is tied together with trussing of angle iron. The space between the two shells is divided into compartments by six plate bulkheads, and the ends are also plated in, as shown in the accompanying view of the vessel. At the center of the hull sixteen buckets are riveted to the outside of the shell.

The propulsion is effected by two sets of engines mounted on platforms, which travel on the inside of the outer shell, one near each end of the boat, in the following manner: Two rails are laid with a gage of 14 feet entirely round the shell. Upon these is a four-wheeled engine platform which carries two boilers and a two-cylinder high pressure engine, which is geared in the ratio of one to two to the forward axle of the platform. When the engines are started, the platforms rotate the cylinder in much the same way as a squirrel turns its cage.

Mr. Knapp informs us that on the trial trip the boat displaced 100 tons and drew 3 feet of water, and that it made 4½ miles an hour when the engines were indicating 15 horse power. The trouble which we anticipated would arise from the water being carried over by the shell did not, Mr. Knapp informs us, occur at the speed obtained at the trial. The combined horse power of the two engines is 100, and their failure to produce better results was due to the slippery state of the rails, caused by condensed steam and insufficient adhesive weight on the driving axles of the platforms.

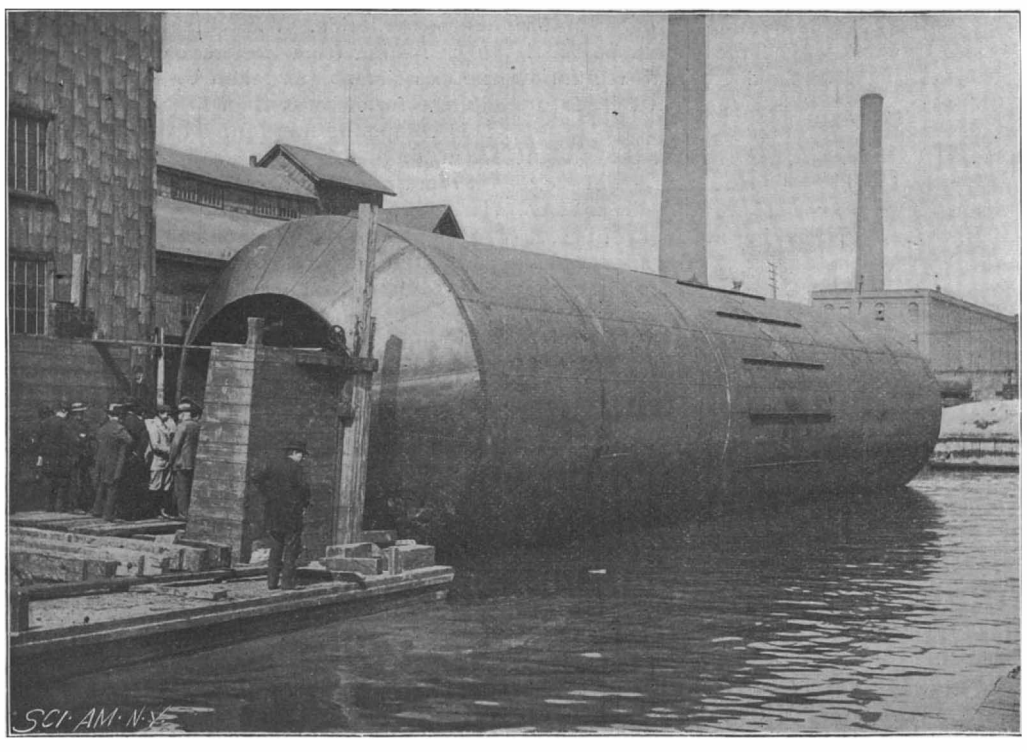


END VIEW SHOWING INNER AND OUTER FRAME AND INTERMEDIATE TRUSSING.



BOAT IN FRAME AND PARTIALLY PLATED.

It was the wish of the inventor to apply the motive power to a central crank shaft rigidly attached to the hull and located at its axis. The engines and boilers were to be carried on a platform suspended from the crank shaft and the whole motive power was to have been located at the mid-length of the hull. A larger boat is now being constructed embodying these changes, and it is expected that the trials will soon take place.



THE KNAPP ROLLER BOAT.

The World's Export Trade.

A translation of an article in the Antwerp Journal of Maritime Interests gives figures of the export trade of leading nations of the world for 1896, as compared with 1872, 000's omitted, as follows:

	Amount of exports.			Rel. rank.	
Countries.	1872.	1896.	Increase.	1872.	1896.
England.....	$1,235,200	$1,422.000	$207,475	1	1
United States ...	430,583	1,050,692	620,109	4	2
Germany	559,700	994,156	384,456	3	3
France....	726.066	656.393	*69,673	2	4
Russia..... ...	270,586	513,908	261,322	5	5
Austria-Hungary	250,900	369,016	118,116	6	6
Belgium.....	193,000	283.324	90,324	7	7

*Decrease.

"The most remarkable feature of this statement," says Consul Morris, of Ghent, "is the decrease in the trade of France, which has fallen from second to fourth place. The trade of the United States, on the contrary, increased more rapidly than that of any other country, or nearly 150 per cent in the twenty-five years. Besides the countries mentioned, Japan, Australia, and the East Indies have, in greater or less degree, increased their exports. France alone sees its trade gradually declining in the volume of the world's commerce."

PICTURESQUE NEW ZEALAND.*

BY MR. SIDNEY DICKINSON, F.R.G.S.

Whenever Nature prepares a continent for the abode of man, she puts beside it some conspicuous island. Europe has its Great Britain; America, its Cuba; Africa, its Madagascar; and Asia, its Japan; and we shall find, in every instance, that either in natural beauty or in developed strength of national character, these islands exercise a strong influence upon the mind of the sympathetic traveler. The great island continent of Australia is no exception to this general rule. If we compare her with Europe, then shall we find in New Zealand the Lesser Britain of the southern seas. It is a very strange and interesting country which lies almost beneath our feet — a country comparatively little known as yet, but coming yearly into better knowledge because of its unexampled beauties and as a resort for the invalid, the tourist, and the pleasure seeker.

It has a stern, rugged coast, of volcanic origin; the whole stretch of this coast is cut out into deep and narrow channels, hollowed out in caves, wrought in shape of pinnacles and spires; no coast is more fantastic, none is more dreaded by mariners.

We steam through the semicircular gulf formed by the two main islands and enter Cook's Straits. Through these straits, more than a hundred years ago, England's greatest discoverer sailed; and his enthusiastic crew gave his name to this channel.

He found New Zealand swarming with a dense and savage population, threatening his great ships with their crazy canoes—courageous and intractable; so Cook turned his vessels away, and after him came traders who introduced rum, muskets, and other like adjuncts of civilization; so that the race of half a million in the time of Cook has been reduced to about thirty thousand now. The principal city is Auckland, from which our tour of the island will properly begin. At its wharves lie the steamships of the San Francisco and Vancouver mail services, and of the Union Company, of New Zealand; fruit boats from Fiji, Tahiti, and Samoa; grain and lumber vessels from every part of the globe. Beyond this shore lies a country of fertile soil and temperate climate, broad rivers, and majestic forests, mountains rivaling those of Switzerland, geysers and spouting springs like those of our own Yellowstone; and in the west coast sounds a new Norway of greater beauty than the old.

The great attraction of the North Island of New Zealand, and one of the world's most remarkable wonders, is found in the hot lakes—certainly one of the strangest and weirdest regions on the face of the earth. The entrance into this country is through a land of broad and rolling fields, lingering rivers, and jagged mountains. The soil is used chiefly for grazing, and a large population is moving already into this beautiful region and doing extremely well with dairy farms and fruit orchards.

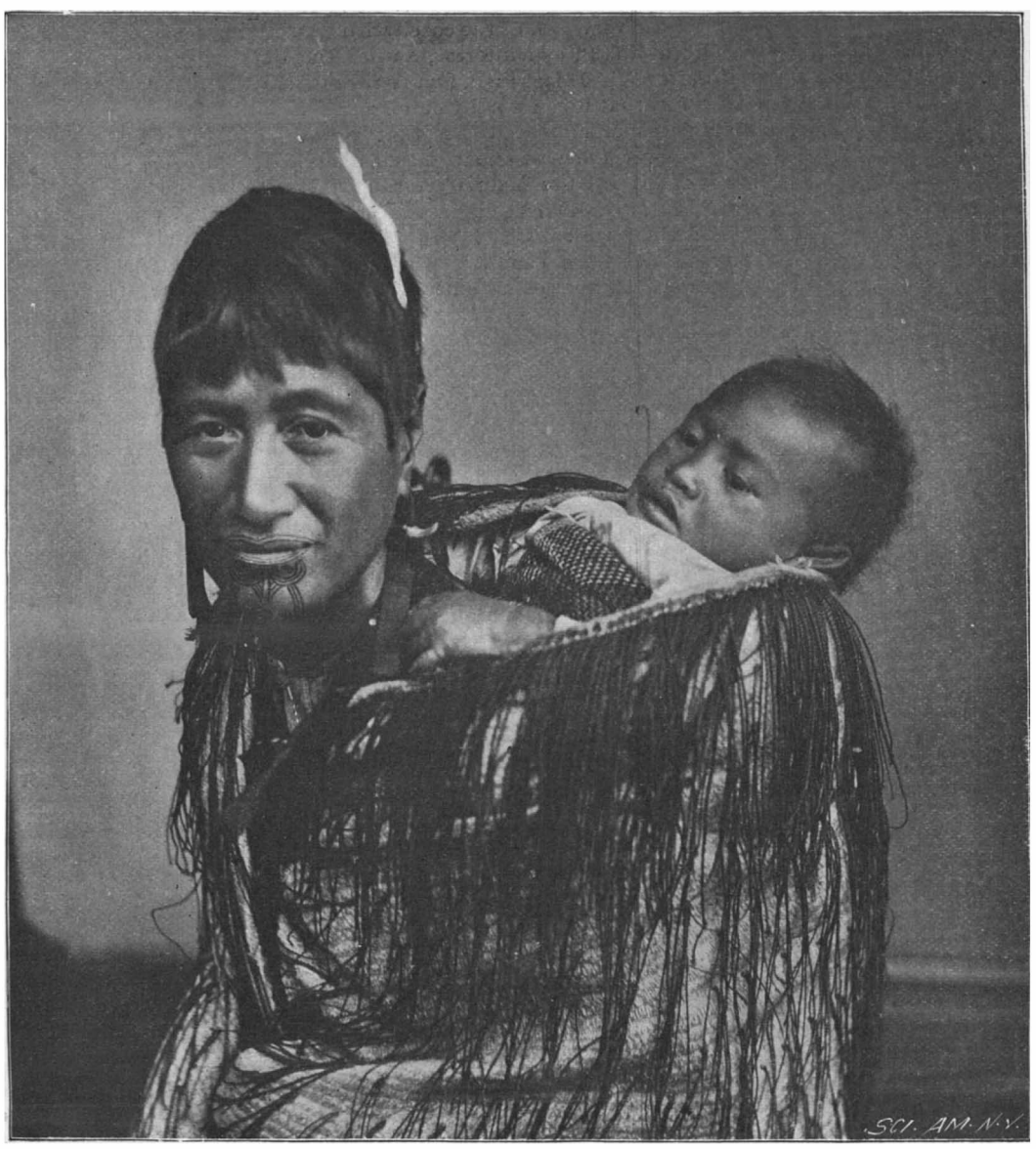
Scattered about through the country are native villages, and upon the hillsides may still be seen the palisades by which the ancient fortified forts were defended. In the native villages of to-day appears the granary, used in common by all the members of the tribe and raised upon posts in order to preserve the store of maize and sweet potatoes from the ravages of rats, upon which animals the Maoris take revenge by serving them up in a nutritious fricassee. As for the natives themselves (who are called the Maoris), let us intrude for a moment upon the privacy of this chief whom we here see enjoying a virtuous repose at the door of his hut. This chief attained considerable fame a number of years ago as companion of that notorious Chief Tekouti in his historic raid against the undefended inhabitants of Poverty Bay, where more than two-score men, women, and children were massacred. It is not a great many years ago that a worthy chief, having conquered a number of his enemies in battle, had his prisoners ranged in a row on the ground before him, and, with his greenstone war club, dashed out the brains of two hundred and fifty of them with his own hand, then threw aside his blood-stained weapon and said, "I am tired; let the rest live," and ordered the carcasses dragged to the ovens.

The Maoris have lost very much of their former skill in architecture and in artistic decoration. To observe of what the former race was capable, let us look for a moment upon this carved front of one of the Maori meeting houses still found here and there about the North Island. It is very curious, interesting, and artistic, too, in a rude decorative sort of way. The figures here are quaint, pot-bellied monstrosities with goggling eyes of mother-of-pearl and hands so imposed as to suggest the pangs of stomach-ache. These figures are not ideal, but are, in point of fact, the portraits of deceased ancestors of the tribe, and appear in the Maori eye as authentic likenesses.

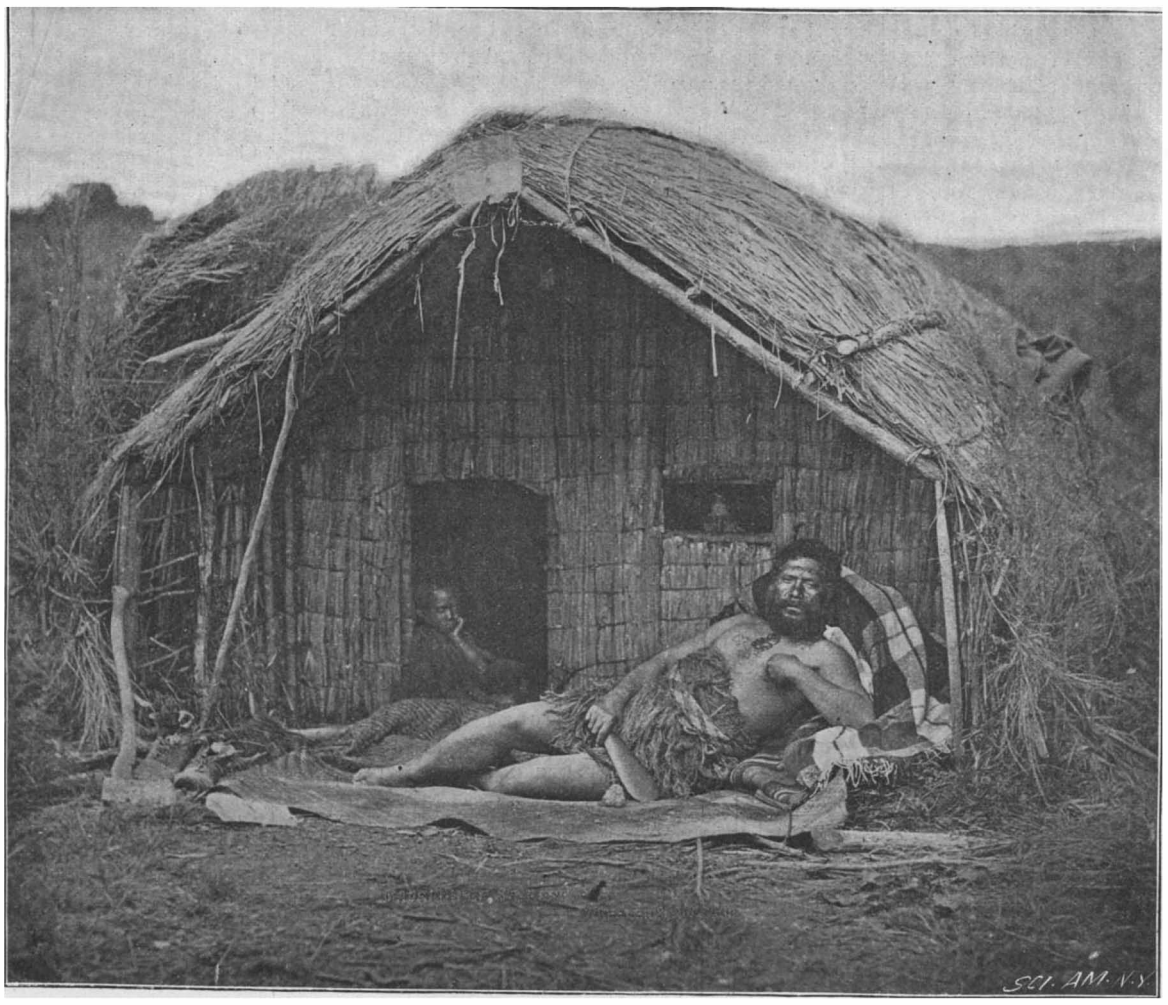
Maori tattooing is something remarkable and still further illustrates the very curious ideas of beauty prevalent among these people in the ancient time. As the Maoris gave over fighting the causes for these hideous disfigurations (whose purpose was to strike terror into the heart of an enemy) passed away. In order to appreciate the full extent of a tattooed warrior's countenance, however, you must imagine the owner of it over six feet high and nearly naked; his features distorted with rage and his tongue hanging out; loud yells issuing from his throat; arms flourishing battleax and war-club, and the whole stupendous aggregation coming down in your own immediate neighborhood at the rate of twelve good English miles an hour. The ancestors of these Maoris were an interesting and intelligent race; and the present degradation cannot be too much deplored. This gentleman was a king, and his name was as elaborate as his facial adornment, namely: Tawhaio Matutiere te Puke-Puke te Pawa te Korate te a'Potatau te Whereo-Whereo.

Finally we came to Oxford, the termination of the railway line; and after a night spent in a very comfortable hotel, we took our seats on the top of one of Carter's line of American built coaches to undertake the thirty-four miles' drive lying between us and Lake Rotorua. About the third of this distance lies through the "Eleven Mile Bush," where we catch glimpses of pleasant scenery. As we approach the town of Ohinemutu, which lies upon the shore of Lake Rotorua, we begin to discern the odor of sulphur. Our road into the town lies between two streams of nearly boiling water; and in the fields upon either side innumerable steam holes blow great masses of vapor into the air. Descending to the shores of this curious lake, we find ourselves walking about in a vapor bath. All around us and close at our feet, as we step gingerly along the narrow pathway, the shallow water of innumerable springs boils and bubbles and the air is filled with the sound of its simmering. If you have any curiosity to know how it feels to have your leg boiled, step but one foot off the narrow pathway and you may make that addition to your store of useful knowledge with surprising suddenness.

A place like this is, of course, a perfect godsend



"TIKI-TIKI," NATIVE WOMAN AND CHILD, WITH CLOAK OF NATIVE FLAX.



MAORI CHIEF AND HUT.

* Lecture delivered at Girard College, Philadelphia. Revised by the author.

to the Maoris. They can soak themselves all day in the warm weather; cook their meat and potatoes simply by hanging them in their nets in the corner of a boiling spring, and live as happily, lazily, and uselessly as the pigs that share their houses and fortunes. All you have to do to launder clothes is to soak a garment in a hot soda spring and then wash it out in warm, clear water in another spring, and there you are. Even if a Maori has but one garment, he is not abashed. He washes it and hangs it on the fence and sits down in the costume of the Greek Slave until it dries.

Each of these floating black heads you see in the warm baths will have a black pipe in its mouth; and if the weather is foul, you may see individuals holding umbrellas over their heads.

Near by is the great geyser of Whakarewarewa, rising from a cone like the most exquisite coral, by which you can climb to the mouth of the crater. There is a dull, thumping sound far down below. You look over to see what is going on; a spurt of hot steam close to your nose suggests caution; you draw back, and a bushel of diamonds are thrown into the air and rattle down the sides of the cone. It is nothing but drops of pure hot water; but it looks like diamonds in the sunlight. Then there is a sudden roar; the air scintillates; and it seems as if all the jewelers' shops had been exploded at once. I have seen many manifestations of Nature in my time; but few where she displays at once her power and her beauty so completely as in this great geyser.

The great attraction of the North Island of New Zealand and one of the world's most exquisite natural wonders is now, unfortunately, nothing but a memory. The great eruption of Mount Tarawera, in 1886, besides destroying more than a hundred human lives, swept out of existence in a moment both the pink and white terraces. The beauty both of form and color in the white terrace neither pen nor brush can describe. It consisted of an irregular series of buttresses and stairs extending in the shape of a half-open fan from a hot water crater at the top and covered a superficial area of about eight acres. It had been formed through unknown years by the action of water heavily charged with silica, which, welling up from a funnel-shaped column of unfathomable depth, slowly built this wonderful staircase, more exquisite than structures carved by cunning artificers of the kings and sultans of the Orient. In the shallow basins forming near the top of the terrace were pools bluer than the heavens, reflecting in their depths all the tints of the harebell and the violet, the water trickling from them and continually crystallizing in new accidents of form and color, each one apparently more beautiful than any that had preceded it. Slowly, year after year, this wonderful structure obtruded itself upon the surrounding forest, and seemed destined at no distant date to cover the whole land with a carved structure of ivory, alabaster, and pearl; but alas! in one night its glory departed and was forever lost under mountains of hideous gray mud and piles of smoking scoriæ.

On the opposite side of Lake Rotomahana was the twin sister of this wonder, the pink terrace, smaller than the other, since it was only eighty feet in height, but with a beauty that was all its own, from that peculiar flush that lay upon it like the flush of sunset upon a frozen cataract or a stairway of marble. The steps were flat in the pink terrace, and at the top was the boiling spring from which this wonder grew. Its waters were as blue as if composed of melted sapphire. Looking into their depths was like looking into the pellucid shallows of the South Pacific, where exquisite shapes of coral and madrepore waver and glisten in an indescribable riot of beauty, both in color and form.

At two o'clock on the morning of the 11th of June, 1886, a terrific explosion took place, the sound of which was heard at Dunedin, 800 miles distant. The sides of Mount Tarawera suddenly gaped open and a column of steam, estimated by competent observers to have been nine miles in height, shot violently up, illuminated to the semblance of a pillar of fire by the glare of the incandescent rockets below. The whole country was shaken with an earthquake, the terraces were blown into space, and the sites they had occupied were covered with mud and scoriæ. As for the unfortunate villages that lay under the side of the mountain, they were utterly destroyed, their inhabitants finding common burial under the crushing masses of rock that were hurled upon them by the resistless power of the volcano. The eruption took place from a series of craters that exploded one after another as if they had been mines connected by a series of fuses, making an irregular rent over seven miles in length and from 400 to 1,600 feet in width.

New Zealand is a country of very remarkable contrasts, which I cannot illustrate better than by transporting you from the regions of steam and fire in the North Island to those of snow and ice in the neighborhood of Mount Cook. The main tourist route includes the ranges and gorges which Capt. Cook very happily termed the "Southern Alps," a curious line of cold lakes, chief among them Te Anau, Manapori and Wakitipu, and the west coast sounds. The journey to Mount Cook is one of peculiar attraction. It begins at Fairlie Creek, upon the eastern coast; and the hundred miles it comprises are covered in two days of stage-coaching. Most of the route lies through mountain gorges, between which shallow rivers are confined, beautiful lakes and flourishing sheep stations, charming views on every hand; and in the intervals we can observe the wild fowl, the paradise ducks, the wood hens, the parrots and black swans which can be brought down from the very roof of the coach with a gun. The whole journey is full of interest; and as the bulk of Mount Sefton, 11,000 feet high, finally rises to mark its close, we feel that it is a worthy culmination of a most remarkable experience. All the other glories of this region, however, fade in comparison with Mount Cook, which is called by the Maoris "Aorangi," the "sky-piercer." It is 12,349 feet high, the capstone of the majestic system which, without ravine or pass that is not choked with eternal snow, stretches along the western coast for a distance of 150 miles. It is covered with glaciers, several of which are larger than any of the Alps, the greatest of all being the famous Tasman Glacier, covering an area of 54 square miles, and constituting a mass of ice unknown to us outside of the region of the polar snows.

A good many naturalists are of the opinion that the giant bird of New Zealand, the moa (generally believed to be extinct), may still be found somewhere among the fastnesses of the mountains, such as we have now seen. Well developed specimens of this fowl, like the one whose skeleton is here depicted, are about thirteen feet in height. At sight of such, no doubt, the hunter's jaw would drop, his arms fall down; while as for the moa, he would undoubtedly gallop off as rapidly in the opposite direction, for according to the local tradition these birds were very timid. It is supposed—in fact, it is known—that within the last hundred years these birds have been alive and walking about in New Zealand. During my visit there I was presented with a thigh bone of one of these birds, which thigh bone was half as tall as myself.

The southernmost city in the world is the city of Invercargill, in New Zealand. The city of Dunedin (about 15 miles distant) is next to it, and is also the metropolis of the South Island, and one of the most interesting towns of the colony. Its location, upon a series of hills, is most picturesque. From an architectural point of view, Dunedin is the first city in New Zealand; and in its high-school building, its university, its several churches, its banks and public offices, gives an example that might well be followed by many municipalities. Dunedin is distinctly of Scotch character, from the fact that it was first settled by colonists of the Scotch Church, who came out from Scotland some fifty years ago, under the leadership of a reverend gentleman named Burns, a grandnephew of Robert Burns.

Five miles below Dunedin lies the port of the town, and from this harbor, in January and February, every year, the Union Steamship Company sends one of its largest steamers on two 10-day excursions to the west coast sounds. The west coast sounds of New Zealand were evidently formed in past ages by glacial action, which is still in operation in the neighborhood of Mount Cook. They occupy about 150 miles of the 400 miles of the west coast, affording the only safe harbors that are to be found in the entire district. Their entrances are narrow and steep and protected by projecting masses of rock.

Milford Sound is the finest of these waterways, and a wonder and delight even to those who have explored the other sounds. It is approached by a way so narrow and winding that the unaccustomed eye can detect no trace of it whatsoever.

Explorations in the neighborhood of Milford Sound have resulted in the discovery of "Sutherland Falls," the loftiest falls in the southern hemisphere. They are 1,904 feet high, and although twice interrupted in their fall by projecting masses of rock, they are, both in form and volume, fully worthy of the enthusiastic descriptions already written about them. Very few eyes have, as yet, looked upon their beauty, for the terrible bush that surrounds them is almost impenetrable.

Insect Stings.

The fact of death occasionally resulting from the sting of insects such as bees and wasps is no doubt largely responsible for the species of terror which the presence of these insects brings upon many persons. Only recently, for example, a case was reported of a laborer who placed in his mouth a gooseberry which proved to contain a wasp. The wasp stung him at the "root of the tongue; he went into his cottage, and medical aid was summoned, but death ensued in five minutes." In this instance, of course, death most probably supervened on suffocation due to intense swelling in the throat, and was not due directly to the poison itself.

Vomiting, fainting, delirium, and stupor strongly suggest a highly virulent substance of the nature of a toxin. The precise nature of the poison of wasps and bees is not known. They possess a poison bag and sting and the fluid secreted is as clear as water, exhibits an acid reaction, and, in fact, contains formic acid But this acid can hardly account for the severity of the symptoms sometimes following a sting. Fatal results have, indeed, occurred which could only be attributed directly to the toxic action of the sting. Some persons, however, endure the sting with impunity, others develop alarming symptoms, such as blood poisoning, and undoubtedly the toxicity of the sting depends very much upon the condition of the "soil" into which it is implanted.

One of the old-fashioned remedies, and we believe a good one, is to apply immediately to the part stung the juice of a raw onion. The rationale of this remedy is not clear, the sulphur oil in the onion possibly serving as a palliative. The sting, at any rate, if it remains in the wound, should be extracted and the puncture dressed with a little weak ammonia and afterward a little bromide of ammonia may be added, which frequently serves as a sedative. Judging from the great number of wasps which have somewhat suddenly appeared in the country during the recent hot weather, this seasonal pest promises to be of no small dimensions. The intense irritation caused in some persons by mosquito bites may be promptly relieved by the application of ipecacuanha, either the "vinum" or the powdered root, made into a paste with water or vinegar.—The Lancet.

Typhoid Fever in the Army.

A commission composed of Major Lee, Dr. V. C. Vaughan, and Dr. Shakespeare, prominent surgeons and members of the Army Medical Corps, spent several weeks in the Southern camps, going over the ground in the most thorough manner possible, and their conclusions have been given in a report to the War Department. The commission is a unit in declaring that the fly is responsible for the prevalence of typhoid fever in the camps, and brings forth facts to support these conclusions. The commission visited the camps at Jacksonville, Huntsville, Fernandina, and Chickamauga. After investigation, the commission concluded that typhoid had undoubtedly been brought by the regiments from the State camps, for at Chickamauga the location was an ideal one, the drainage being good and the water excellent. The commissioners found that flies were present in the camp by the million. They fed off refuse matter from the hospitals, and at meal times shared the hardtack and bacon of the soldiers. Of course, this made an excellent means of transferring the germs of the fever. Hundreds of flies which swarmed on each table served to inoculate a large number of soldiers. The inoculation was slow but sure, and when the systems of the soldiers became weakened by exposure, the disease developed rapidly. The commission found that in all the camps typhoid did not appear in isolated cases, but that whole messes went down with the disease at the same time, showing conclusively that the fault lay with the food.

To prevent the ravages of the disease in the future, and to protect the soldiers from the fly, the commission has recommended that a new sink be used by the camps. It is now possible to have water connections in every camp, even where connections cannot be made with sewers. The commission therefore recommends that metallic-lined sinks be constructed, sixteen feet in length, two feet in width and eighteen inches in depth. These troughs are to be slightly inclined and a connection made with a water pipe at one end. The other end is to project from the house and is to have a waste pipe three inches in diameter and an upright pipe of the same diameter about sixteen inches in height. Every day this trough is to be partly filled with water in which a sufficient quantity of lime is to be placed. The waste matter will thus be disinfected as soon as deposited and all danger will be avoided. Every morning the sink will be cleaned by flushing it through the waste pipe into a covered sink, or it can be flushed into barrels, properly covered and carried to some distant place to be dumped.

The commission will also recommend that in the future movable sinks shall be constructed after the above pattern and placed on wagons. The whole apparatus can then be moved every day, and the contents of the trough deposited in a safe place. These wagons can accompany the army on the march. The commission will strongly urge that in every case care shall be taken to disinfect such matter as soon as possible by the use of lime and other disinfectants. The members hope that by this means the fly will be prevented from reaching the fæcal matter, and even if he does, it will have been disinfected and can do little or no harm. As the army cannot carry screen doors or otherwise protect itself from the fly, the commission believes the best thing to do is to render his attacks harmless.

"THE barbed-wire fences surrounding Santiago," says Electricity, "which have proved a hindrance and nuisance to our hard-worked soldiers, have, it seems, after all, their advantages. Not long ago one of the wires of such a fence was sufficiently insulated to allow of telegraphic messages being sent from one army corps to another, a distance of five miles. Thus the Spaniards unwittingly saved the enemy's signal corps the trouble of laying a wire through a rugged country."

CALIFORNIA HARVESTING MACHINERY.

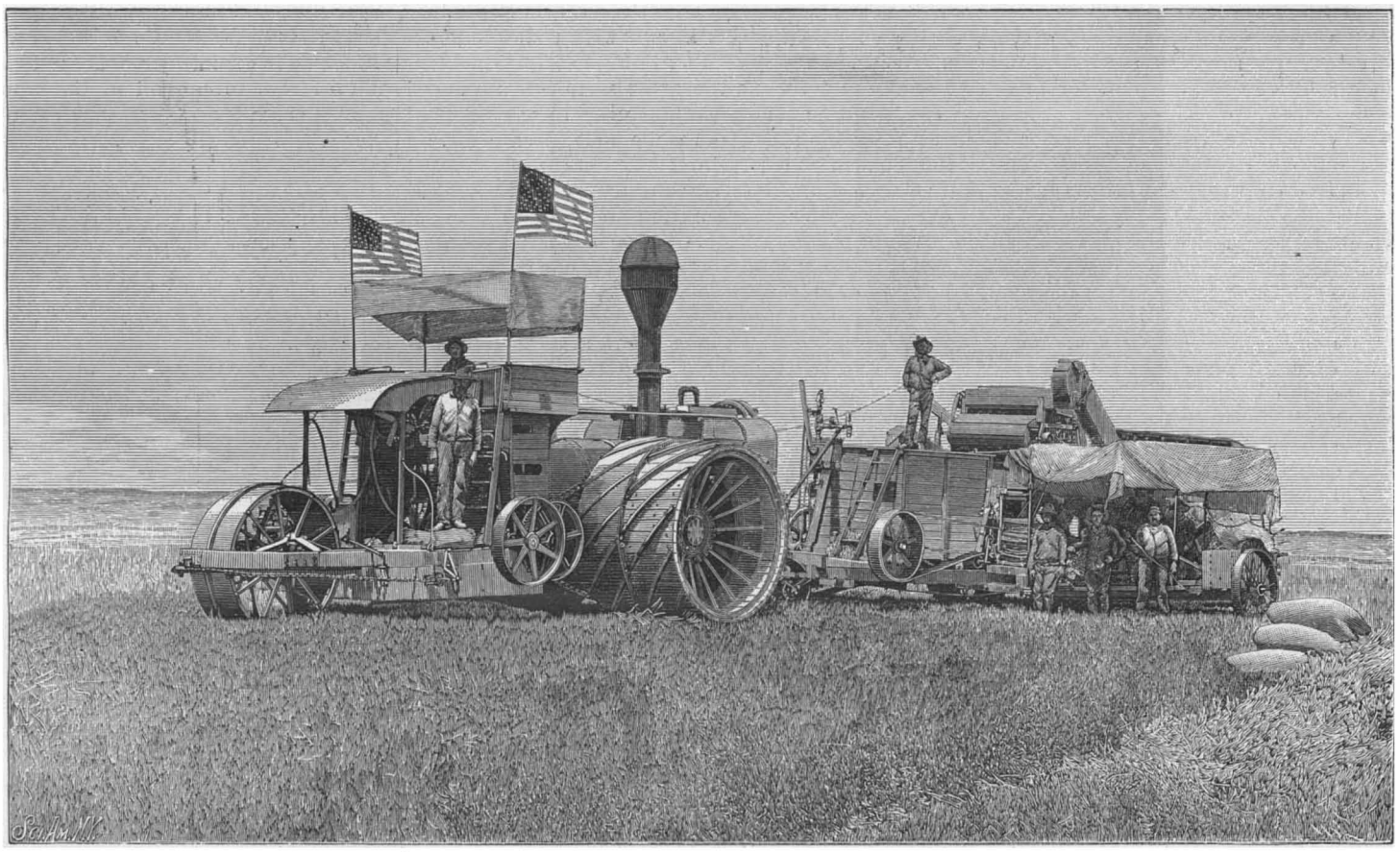
BY FRANK COVEY, M.E.

The accompanying illustrations show a right and left side view of the Laufenberg traction engine and combined harvester as used in the great wheat fields of California and the Pacific coast States.

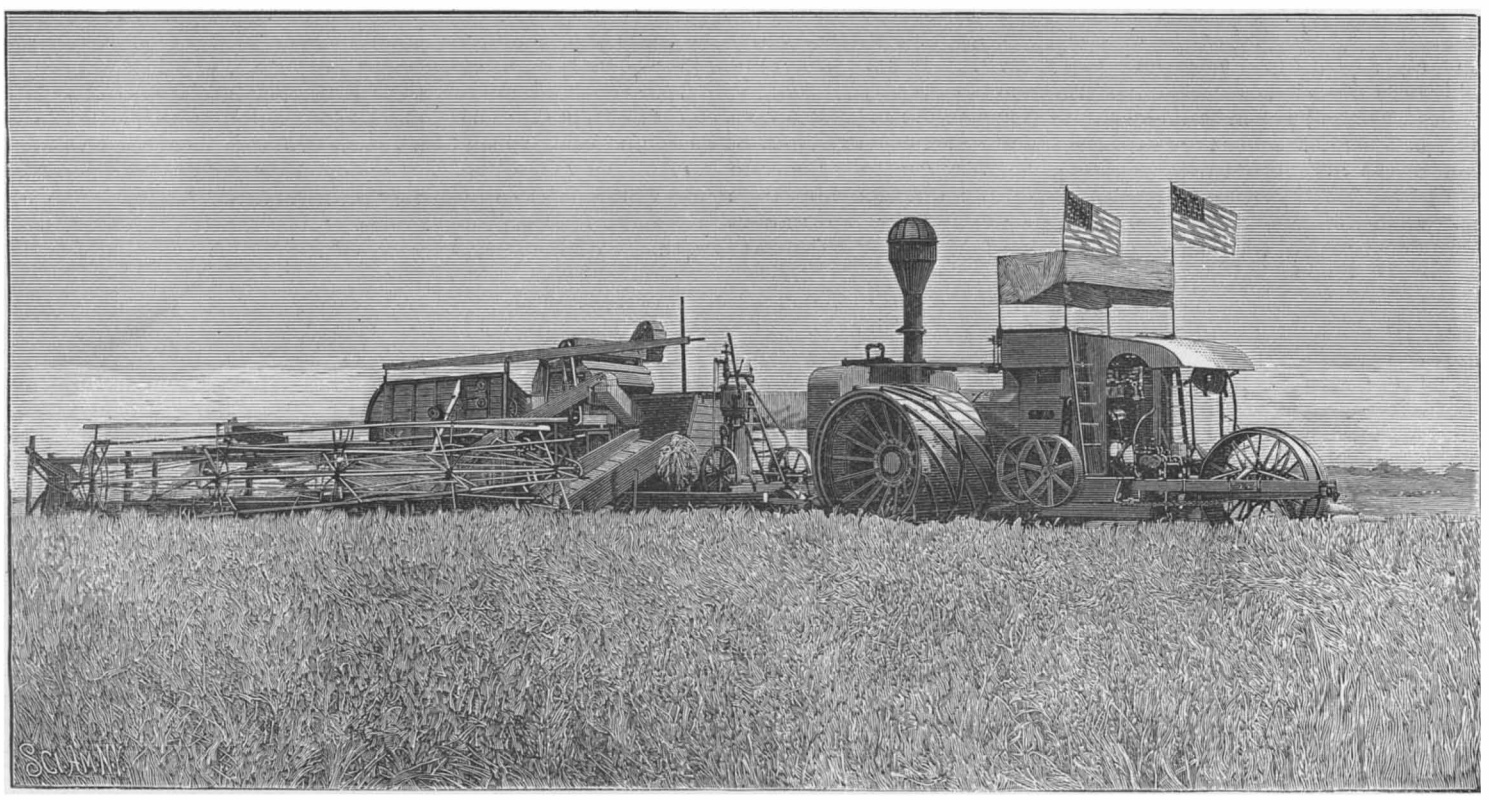
The harvester cuts a swath 28 feet wide and thrashes, cleans, and sacks the grain as it moves along. It would seem that a machine cutting a strip of grain 28 feet wide would be handling straw fast enough to satisfy almost anyone, but the Laufenberg machine has been built to cut a nice little swath of 52 feet and sack the grain, completely cleaned and ready for market. While the combined harvester is not a new feature in the handling of crops on the coast, only recently, and not until the traction engine became a success in the field, did they ever attempt a cut wider than 18 feet; 16 feet being the standard machine, requiring from 30 to 40 head of stock to handle them.

In the machine shown herewith an auxiliary engine is located on the front end of the harvester to operate the thrashing and separating machinery and is furnished steam from the boiler of the traction engine. The engine and boiler of this monster outfit are also a departure from the stereotyped plan usually met with in traction engine construction, there being two upright stationary engines, one on each side, and bolted to the main frame, instead of being attached to the boiler, as usual in engines of this character. The cylinders are 9 by 10 inches, and combined they are capable of developing 60 horse power, and either may be run independently of the other. The same patterns are used in the auxiliary engine on the harvester, and with this plan the steam power harvester has been made a complete success. While the horse power machines are still in the majority, yet for extensive harvester work, where large acreage is to be dealt with, the steam rig will undoubtedly become the favorite, the separator capacity thereby being increased. The cylinder of the machine shown in the cut is 40 inches and the separator or shoe is 56 inches wide. It would seem that the small boiler used to supply the three 9 by 10-inch engines would be hardly equal to the task, but, from its peculiar construction and adequate steaming qualities, it more than supplies the demand. It is a 40-inch shell boiler, but Mr. Laufenberg claims it to be —which undoubtedly is correct—a compartment boiler, the shell extending back into or over the fire box, and the flues are so constructed that as a steamer it is a marvel.

The extension wheels are put on to carry the heavy machine over soft or sandy ground, this particular engine having been built especially for use on tule or reclaimed swamp land. When the writer visited the ranch to obtain data regarding this monster of California farming, they were cutting, thrashing, cleaning, and putting in sacks at the rate of three sacks per minute of barley, each sack weighing one hundred and fifteen pounds, requiring two expert sack sewers to take the grain away from the spout, sew the sacks, and dump them on the ground. Seven men constitute the whole crew, including engineer and fireman. The machine is the property of Brant Brothers, of Union Island, near Stockton, California.



A GREAT TRACTION ENGINE AND HARVESTER USED IN THE WHEAT FIELDS OF CALIFORNIA.



HARVESTER CUTTING A SWATH 28 FEET WIDE.

A Motor Carriage Exposition.

The executive committee of the Massachusetts Charitable Mechanic Association have set apart over 20,000 square feet as space for a motor carriage exposition at the Twentieth Triennial Exhibition, which will be held in their exhibition building, Boston, Mass., from October 10 to December 3. No charge will be made for space, but each exhibitor will pay an entrance fee of $5. Every facility will be furnished exhibitors for the care of their vehicles, and fuel will be provided for exhibition races. If a sufficient number of contestants can be procured, a race and general contest will be held at Charles River Park, and prizes amounting to a considerable sum will be offered. Competing vehicles will be divided into three classes—steam, hydrocarbon, and electric. Boston, with its splendid roads and its beautiful suburbs, is an ideal place for the introduction of the motor carriage, so that no such opportunity has ever before been offered motor vehicle manufacturers in this country.

Possible Extension of the Subway.

The success which has attended the operation of the completed subway system in Boston is so great that citizens are desirous of having it extended. The Rapid Transit Commission has sufficient power to extend the subway to East Boston, if it is thought desirable. In that case, of course, a tunnel would have to be built under the harbor, but the government will not oppose the construction of such a tunnel if it is desired to build the subway.

THE "MERCERIZATION" OF COTTON FABRICS.

Considerable interest has been aroused among cotton manufacturers by a new process of "mercerizing" under tension, in which the fiber under treatment, it is claimed, assumes a peculiar silk-like gloss that adds much to the appearance of the fabric. In order to explain exactly how this novel effect is produced, we have prefaced our article with an account of the old process of "mercerization" and reviewed the discoveries made by an Englishman nearly a half-century ago.

In 1850, the British government granted to John Mercer, calico-printer and chemist, a patent for a new and curious process of treating cotton cloth—a process which greatly increased the strength of the fibers and which imparted to the fabric "greatly augmented and improved powers of receiving colors in printing and dyeing."*

Mercer's process, in brief, consisted in treating cotton cloth with caustic alkalis, with acids, or with zinc chlorid. The individual fibers, it was found, became shorter and thicker after treatment, the strength of the cloth was greatly increased, the cotton assuming a translucent appearance and dyeing far more rapidly than ordinary vegetable fiber.

Scientifically considered, the process of mercerization forms one of the most interesting chapters in the chemistry of cellulose. Treated with caustic soda-solution (sp. gr. 1·23 to 1·28) at ordinary temperatures, the remarkable thickening and contraction in length already alluded to, takes place. The effect on cotton cloth may be described in Mercer's own words: "I spotted bleached cambric with single drops of caustic soda-solution (1·3 sp. gr.), and noticed that the central portion of each drop became semi-transparent and contracted; around this was a rim neither semi-transparent nor contracted."

In cloths, the contraction is about 20 to 25 per cent; the increase in strength measured by the breaking strain on isolated threads, about 50 per cent. Moreover, an increase in weight over ordinary cotton is noticeable after mercerization, due probably to the excess of hygroscopic moisture. According to Mercer's own experiments, it seems that the action of the alkali is the result of a combination with the cellulose of the cotton, represented by the chemical formula $C_{12} H_{20} O_{10} Na_2O$, cellulose having the formula $C_{12} H_{20} O_{10}$. On washing, water takes the place of the sodium oxid, and the hydrate, $C_{12} H_{20} O_{10}. H_2 O$, is formed, a degree of hydration producing an increase in weight of 5·5 per cent.† This water of hydration is readily expelled by heat, but is reabsorbed on exposing the fiber to the atmosphere. The change in the physical and chemical condition of the cotton cloth after mercerization is therefore permanent. Dr. Gladstone‡ in his experiments on mercerized cotton found that after exhaustively treating the fiber with alcohol to remove the excess of alkali, a proportion of the latter is still retained corresponding to the formula 2 ($C_{12} H_{10} O_{10}$). Na_2O, the compound being easily decomposed by water and carbon dioxid.

These reactions of cotton fiber with caustic soda vary considerably with the temperature of the solution, "the variations being the inverse of those usual in chemical reactions, the effect being retarded by increase in temperature."§ Solutions at the ordinary atmospheric temperature seem to act most effectively. It is also found that hydrated zinc oxid increases the action of the alkalis. Zinc chlorid in strong solution acts on cotton fiber in a manner similar to that of the caustic alkalis, and is therefore included by Mercer in his patent.

Like results are obtained by treating the cotton with dilute sulfuric acid. Although the changes which occur during the acid treatment are also to be attributed to hydration, the effects produced are sometimes different and opposite in character.‖ Sulfuric acid of 1·35 specific gravity, nitric acid of 1·3 specific gravity, and concentrated hydrochloric acid gradually disintegrate the cellular fibers at ordinary temperatures. The first action, however, is the toughening accompanied by linear shrinkage so characteristic of mercerized cotton.

Crum,‖ who examined mercerized cotton microscopically, found that the action of the caustic alkalis produced changes in the physical structure of the fiber, in every way similar to those which take place in the ripening of the fiber while still on the plant. From a flattened tube with a large central cavity, the fiber changes to a thick-walled cylinder with small lumen. In their normal state the fibers are, moreover, spirally twisted about their longitudinal axes, and when spun or woven still retain this formation. When mercerized, the fibers are no longer twisted, but become more or less rounded and compact. From a cellular tissue, the fiber changes to a glutinous, colloidal, and ductile substance.

In spite of the many advantages possessed by mercerized over ordinary cotton, its great shrinkage increases the cost of manufacture to such an extent, that the process has not been generally used.* Technically, mercerization has hitherto been employed chiefly in the preparation of piece-goods for turkey-red dyeing and in the manufacture of calico-printer's blankets for machine printing.† In France the property possessed by vegetable fiber of becoming shorter after mercerization has been employed by a Lyons firm to produce peculiar embossed effects in silk webs containing cotton threads.

In order to overcome the great shrinkage produced by mercerization, many manufacturers have attempted either to stretch the cotton while under treatment, by clamping it in the stretching machines usually found in dyeing and finishing establishments, or to subject it to tension after mercerization, in order to bring it back to its original length. In both these operations the short, loosely spun fibers slip over one another and thus produce an elongation of the material.

Following in the footsteps of previous experimenters in attempting to stretch long fiber and hard spun mercerized cotton to its original length, Richard Thomas and Emanuel Prevost, of Germany, found that the machines ordinarily used for the purpose were not powerful enough. They therefore devised more powerful apparatus, which would subject the fabric to a greater tension and which would sufficiently elongate the cotton. During this powerful stretching of long fiber or hard spun cotton, they made a most remarkable discovery. The cotton cloth, it was found, assumed a brilliant silk-like luster, a certain glossy appearance, which the discoverers claim was due to the fact that the fibers no longer merely slipped over one another, but to the fact that the individual fibers were themselves stretched, thus producing the peculiar glossy effect. An important element of this process, besides the increased stretching, seems, therefore, to lie in the use of long fiber or hard spun cotton. This silk-like luster produced by mercerizing under increased tension has many analogies in the arts. We find it present, for example, in "pulled" candy or drawn molten glass.

The new process, therefore, presents the advantages not only of producing a strong, easily dyed textile fabric, but of adding a gloss which materially adds to the value of the fabric. So far as the results obtained by the process are concerned, it seems immaterial whether the cotton is first stretched and then mercerized, the latter process causing the fibers to contract sufficiently to produce the silken appearance, or whether the cotton is first mercerized, and while subjected to the action of the caustic bath, is elongated by machinery. This attenuated condition of the fiber is rendered permanent, either by maintaining the tension until the mercerizing alkalis or acids have been completely removed or neutralized, or by stretching the fiber previously beyond the necessary amount and then allowing the threads to contract to the required length while subjected to the process of mercerization.

Ordinary mercerized cotton, it is true, possesses a certain natural gloss of its own; but between this natural gloss and the artificial silk-like brilliancy produced by stretching, a very sharp line can be drawn. Ordinary mercerized cotton merely has a semi-transparent, parchment-like appearance; long fiber or hard spun mercerized cotton, stretched according to the Thomas and Prevost process, possesses more the characteristic luster of silk—a distinction, it seems, which is not very generally understood.

An impression appears to prevail among cotton-manufacturers, that the new process of mercerizing under tension is by no means new, that the patent granted to Thomas and Prevost is merely a renewal of a patent for an old, long-forgotten process. True it is, that mercerizing under tension has been known for some time. We find it employed by many manufacturers both at home and abroad. But it is claimed by the inventors that no one has hitherto stretched mercerized, hard spun, or long fiber cotton to an extent sufficient to produce the effect which we have described. Something analogous to the Thomas and Prevost treatment is found in a process which subjects cotton to a preliminary mercerization and stretching, and then treats it with a solution of silk to impart the well-known appearance of silk. Although both tension and mercerization are used in this process, it does not necessarily follow that the silken gloss is produced by tension; it appears to be due rather to the silk solution. Small as the departure of the Thomas and Prevost process has been from the means previously employed in mercerization, the results nevertheless appear to be widely different and valuable.

It has been already observed that the expense incurred by the old process has affected the general use of mercerization. Whether a similar cause will affect the manufacture of fabrics by the new process, or whether the superior silken quality produced will compensate for the increased cost, only a cotton manufacturer can say.

* Mercer: quoted by Thorpe: "Dictionary of Applied Chemistry."

† Thorpe: "Applied Chemistry." Article on Cellulose.

‡ Journal für praktische Chemie, Vol. 56. See also Quarterly Journal of the Chemical Society of London, Vol. 5.

§ Thorpe: *Loco citato.*

‖ Journal of the Chemical Society of London, 1863.

* Knecht, Rawson, and Loewenthal: "Handbook of Coloring and Spinning Fibers."

† Thorpe.

Exploring Coral Reefs.

An interesting preliminary report of the scientific investigations by the Agassiz expedition in the Fiji Islands has just been brought to Sydney, New South Wales, and from there to San Francisco. The report was written by Prof. E. C. Andrews, who led the expedition. It states that the progress of boring through the reef at Fannafuti is very rapid. The explorers have secured several rare specimens of coral. The most important undertaking of the expedition in the matter of Crater Lake exploration was the trip of Profs. Sawyer and Andrews to Taviuni and its crater lake, 2,800 feet above the sea level. The start for the lake was made over Razor Back, that led them 3,000 feet above the sea, and from which height they could get a fine view of the lake. The ascent was made with the greatest difficulty and much suffering on their part. The tropical vegetation to the edge of the crater was marvelous in its density. The report says that the growth was so dense that at midday, while cutting paths toward the summit, the sun was entirely obscured, the effect being the same as in a forest when the sun is down and its refracted rays have all but vanished. In some parts it was pitch dark, and their path had to be changed to places which were less hampered by brush and closely interwoven branches overhead.

Passing through this belt into a less wooded part of the mountain they made their way through mud holes which brought them to the crater's edge. From there to the level of the lake was a hard climb down the steep hillside covered with decayed vegetation. A swamp lay between them and the clear water. The two professors sank to their hips in the muck, and the stench from the ground was almost overpowering. It was noon when they landed on a piece of hard ground at deep water. The lake itself is blue and clear, but sounding lines failed to find bottom even when 600 feet of cord had been paid out. Numerous specimens of great scientific value were secured.

The expedition next goes from Taviuni to Mango, where there is a crater whose rim is a raised coral reef.

The "Indiana's" Punch Bowl.

The "Indiana" has a silver service of twenty pieces, and one of them, a punch bowl, has received an honorable scar resulting from a too near approach to the Zocapa mortar battery, near the entrance to Santiago Harbor. On July 3, while the "Indiana" was cruising near this battery, a shell struck the quarter-deck, piercing the armor, and burst in the wardroom. A fragment of shell 5 inches long, and varying from 2 to 4 inches in width, hit the bowl on the engraved side, but fortunately not until its speed was well spent. The dent covers a space of about 4 inches, and it is regarded with great pride by the officers and crew. The punch bowl has been sent to Messrs. Tiffany & Company to have an account of the injury engraved across the damaged portion of the gilt lining. The fragment of shell has been preserved and will be mounted on an ornamental openwork silver cover for the bowl.

The Current Supplement.

The current SUPPLEMENT, No 1188, contains a number of addresses, papers, and articles of more than general interest. "The French on the Upper Nile" is accompanied by a map which will be of value, now that Gen. Kitchener's army is so much in the public eye. "Bottle Drifts" has a map which shows the pilot chart of bottle drifts on the Atlantic Ocean for August, 1898. "Greenhouse Heating," by Thomas N. Thomson, is a very practical article, and is accompanied by clear diagrams. "The Division of Clock Dials" describes some very curious dials on old clocks. "The Use of Bamboo Among the Annamites" is an interesting article which describes the use of bamboo to make enormous norias, or immense wheels for raising water. This issue of the SUPPLEMENT contains three important addresses and lectures. "The Inaugural Address" of Sir William Crookes, President of the British Association, is begun in this number. Prof. Barnard's "The Development of Photography in Astronomy" is continued, and Prof. F. P. Whitman's "Color Vision" is begun.

The attention of our readers is called to the fact that the SUPPLEMENT each year publishes a number of lectures, papers, etc., by scientists both at home and abroad, and in many cases these lectures are not published elsewhere.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

PULVERIZER AND HARROW.—ANDREW V. NELSON, Galesburg, Ill. This invention involves the peculiar construction of harrow teeth so arranged that they can be quickly removed or attached to a series of square-shaped revolvable horizontal bars forming the main part of the harrow which are secured and have bearings in three longitudinal bars. To convert it into a pulverizer, additional teeth are attached to the revolvable bars pointing in opposite directions. As the harrow is drawn along, they cause the bars to revolve and at the same time crush and pulverize the earth underneath. To change it to a harrow, the surplus teeth are detached, leaving the balance pointing in one direction. By a simple device the series of revolvable bars are locked to a crank-arm above the harrow attached to a hand lever. The operator, by moving the lever, can adjust the teeth to any desired angle, locking it with the usual supplemental spring-pushed pin attached to and parallel with the handle lever.

Bicycle Appliances.

BICYCLE-SADDLE.—JOHN B. MCMANUS, Schenectady, N. Y. The purpose of this invention is to construct a light bicycle-saddle that will automatically adjust itself to the body of the rider, and that will be adapted for use on the saddle post without the necessity of an intermediate spring. To this end, the inventor forms the body of the saddle from a single piece of spring-metal, bent upon itself in a number of coils, the inner terminal being doubled on itself and extended longitudinally in opposite directions to reinforce the inner turns of the coil and form an attaching shank.

Electrical Inventions.

ELECTRIC FURNACE.—RICCARDO PIGNOTTI, FERDINANDO LORI, SCIPIONE REGNOLI, MARCO BESSO and MAFFEO PANTALEONI, Rome, Italy. To provide a furnace with double recovery of heat-activity for the production of carbids, these inventors have devised a furnace having a refractory and non-conducting lining. The furnace has a removable carbon bottom with an aperture therethrough containing a carbon plug mounted on a lever. A high-resistance electrode is suspended in the furnace and has a portion extended upwardly into the chamber communicating with the furnace. A receptacle is provided for the material to be treated and communicates with the furnace. A screw conveys the material from this receptacle to the furnace. In a chamber or space surrounding the receptacle, gas-burners are located, which are designed to heat the material in the receptacle before its transfer to the furnace.

ELECTRIC BATTERY.—VICTOR JEANTY, Paris, France. The main feature of this battery is that its exciting liquid, chemically considered, is kept separate from the depolarizing liquid, although electrically the electrodes are directly connected, while as regards the relative quantities of the liquids contained in the cells, constant proportions are maintained. This arrangement, therefore, affords a means for removing the inconveniences met with in the batteries now in use. Moreover, a current of great intensity and uniformity of tension is obtained at a minimum cost.

Engineering Improvements.

TRACTION-ENGINE. — ROBERT J. ZERBAN, JR., Belleville, Ill. The object of this invention is to provide a traction engine so arranged that the boiler hangs in springs, that the driving mechanism is always in mesh and that friction is reduced to a minimum. The axle-frame is U-shaped, is fulcrumed at its middle on the boiler and carries at its ends alined spindles for the traction or rear wheels. Spring are interposed between the boiler and the frame at the spindles and take up all vertical movement of the boiler. A countershaft is carried by the pivot-portion of the axle-frame and is provided with intermeshing gears operating the wheels. No matter which way the boiler moves relative to the traction wheels, the intermeshing gear will always remain in proper position so that no binding takes place.

Mechanical Devices.

REGISTERING APPARATUS.—LEONARD D. ORR, Pegram, Ill. This apparatus consists of a shaft, a registering disk loosely mounted thereon having a concave cavity, a transmission-disk fixed to the shaft and seated in the concavity of the registering disk, and a spring-bearing between the transmission-disk and the registering disk to transmit movement from the transmission-disk to the registering-disk. A stop-plate is fixedly mounted adjacent to the registering disk and is engaged by a dog carried by the registering-disk to hold that disk until released by the action thereof.

KNITTING-MACHINE.— ISAAC W. LAMB, Perry, Mich. The object of this invention is to provide an improved machine designed more especially for knitting mittens, gloves, and similar articles and arranged so as to produce tubular fabrics or fabrics open at one end. The apparatus consists principally of two rows of needles, a reciprocating carriage, sets of cams on the carriage to operate the rows of needles, and a manually-actuated shifting device adapted to be set in two positions, one to open and close the cams alternately to actuate the rows of needles successively during a full stroke of the carriage to form a tubular fabric; and the other to open one set of cams and close the other set during a full stroke of the carriage and then to open the other set and close the first set of cams during the next full stroke of the carriage, to produce a fabric open at one end.

GRAIN-BAGGING MACHINE—JAMES W. HENRY and ALEXANDER GUNN, Wallace, Idaho. To provide an apparatus properly arranged to support and hold open a sack while filling, to sew up the open end of the bag after it has been filled, and, finally, to discharge the filled and closed bag from the machine, is the purpose of this invention. The machine has a frame in which is mounted a revoluble bag-carrier comprising a table and a top sustained adjustably above the table. On the bag-carrier a dumping-board is mounted between the top and the table, which board ejects the bag from the table. A stationary jaw is formed adjacent to the dumping board. Mounted next to the stationary jaw and coacting therewith is a movable jaw to which a rod is connected carried by the bag-carrier. The movable jaw serves to hold the bag in open and closed positions. When the jaw is in closed position, the bag is sewed.

POWER-WHEEL—ALMER N. BLAZER, Mescalero, New Mexico. According to this invention, two angularly-disposed shafts are horizontally carried by a hollow shaft. To each shaft two blades are pivoted, adjacent to which are arms fixed to the shafts and serving to limit the movement of the blades. An arm is carried by each blade. On each of the angularly disposed shafts a finger slides which may be moved in and out of engagement with its respective arm to release or lock that arm.

MARINE PROPULSION—EDWARD W. MITCHELL, Oberlin, O. This invention provides one or more reciprocating propellers, which slide back and forth along the hull of the boat. Each propeller consists of a carriage to which a blade is pivoted. In the carriage a support provided with a rack slides and extends on opposite sides of the blade. Braces connect the support with the blade. To the carriage a drum is journaled having a pinion meshing with the rack of the support. A cable is wound at its ends on the drum. An adjusting means is provided whereby one of these ends may be wound on and the other correspondingly wound off the drum to effect an adjustment of the blade whereby the direction of motion may be changed.

Miscellaneous Inventions.

SHIP'S BANDAGE.—CARL F. SULTEMEYER, Chicago, Ill. A flexible cloth structure is provided by this inventor to blanket or bandage a leak in the hull of a vessel so as to exclude the water. The bandage on one side has overlapping flaps, which, when the bandage is rolled, project out tangentially from the roll, so that the pressure of the incoming water, acting on the flaps, will unwind the roll and spread the bandage over the surface of the vessel. The action of the inrushing water acting on the unfolded bandage presses the material tightly into the leak and thus excludes the water.

SPRING-HUB FOR VEHICLE-WHEELS. — CONSTANT CASIMIR BALLIN, Paris, France. The device forming the subject of the present invention provides a flexible hub applicable to all kinds of wheels. A wheel fitted with this elastic device possesses great strength. The elasticity is better distributed at the spring-hub than over the circumference, all shocks or thrusts being relieved by an India-rubber cushion interposed between the wheel and the axle-journal. The latter consequently cannot readily be broken.

CANDLE-BURNING LANTERN FOR VEHICLES. — ALEXANDER BOCK, Copenhagen, Denmark. The present invention is an improvement in the construction of candle-burning lanterns for vehicles. The purpose of the inventor has been to keep the "candle-cup" dry, and thus avoid the drawbacks hitherto experienced with candle-lanterns. The lantern consists of two main parts —the lantern-space and the candle-holder. These two parts are connected by a piece made of cork, wood, or the like. The heat of the lantern-space is thereby prevented from penetrating the walls of the lantern-space and reaching the candle-holder.

METHOD OF FORMING TOBACCO INTO WRAPPERS.—PATRICK DILLON, Milford, Mass. By means of this method, sheet-wrappers for cigars can be made from refuse tobacco, such as stems, scraps, and siftings. In carrying out the process, the stems or stalks are first beaten into a pulp and immersed in a solution of tobacco juice. The scraps are then taken to another beating-engine containing steam. The pulp is then rolled out. Manila and Egyptian hemp are added to make a suitable binding fiber. The whites of eggs are used to give the finished sheet a glossy appearance. A solution of tea-leaves may also be employed to flavor the wrapper.

BRUSH.—DRYDEN B. FORWARD, Alturas, Cal. The brush provided by this invention is formed of wire and is produced by twisting together a number of strands so that they shall be given a crimpled form, and by untwisting the strands partly so as to make the individual bristles of a brush.

THILL-COUPLING.—LOUIS E. MACOMBER, Ashland, Wis. The purpose of this invention is to provide a coupling which may be quickly manipulated and which enables a person seated in a vehicle to release an unruly horse. The thill-coupling comprises an arm adapted for attachment to the axle and has a recess adapted to form a seat for the cross-bar of the thill-iron. A transverse groove and a transverse rib are located in the recess and the attachment end or axle end of the arm. A jaw is pivoted to the free end of the arm, which jaw has a recess to fit the cross bar of the thill-iron. At its free end the jaw has a transverse rib and a transverse groove adapted to interlock with the grooves of the arm.

KNOCKDOWN STOVE.—JOHN F. PJERROU, West Point, Neb. The stove devised by this inventor may be packed in an exceedingly small space, and is hence especially adapted for use in camping out. The stove has a body in which an oven is set. On the top of the oven are sockets adjacent to which is a damper. Flue-plates are arranged to be engaged by the damper, each comprising a lower member hinged to the bottom of the oven and an angular member pivoted to the lower member and arranged to engage the sockets. A grate is also provided in which coal, green wood, or seasoned wood can be burnt.

FENCE.—MANSON STEFFEE, Akron, O. This improved fence comprises panels spaced apart, one of these panels having guideways and the other lap extensions projecting toward the first panel. Crossed stakes brace the panel provided with guideways. Stakes are crossed below one of the lap extensions of the other panel. A slide-panel has its bars arranged to slide in the guideways of one panel and is provided at its end with lap extensions corresponding with those of the panel toward which the slide-panel is movable. The fence is designed to rest entirely upon the ground and requires no anchoring whatever. From the nature of its construction, it may be built very lightly, thus enabling it to be compactly loaded.

Designs.

PARING-KNIFE.—MAURICE E. HADDEN, Savannah, N. Y. This design consists of a handle from which projects a knife-blade formed with a double curve extending through the entire length of the blade. The back is curved downwardly near its outer end to terminate in a point, the curved portion being concave. The blade of this knife is adapted to fit the shape of the fruit to be pared, thus enabling the skin to be removed without cutting away too much of the fruit.

TIE FOR BAGS.—EPHRAIM L. SCHANCK, Delaware, O. The leading feature of this design consists in a tie having a loop and arms departing from the loop in opposite directions at an angle to each other, one of the arms being returned on itself.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for 10 cents each. Please send the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

INSPECTION OF MATERIALS AND WORKMANSHIP EMPLOYED IN CONSTRUCTION. By Austin P. Byrne. New York: J. Wiley & Sons. 1898. Pp. 539. 16mo. Price $3.

The present work is a reference book for the use of inspectors, superintendents, and others engaged in the construction of public and private works, containing a collection of memoranda pertaining to the duties of inspectors, quality and defects of materials requisite for good construction, methods of slighting work, etc. This book will undoubtedly prove of great value to inspectors of private works and should be to inspectors of public works. If the public official whose duty it is to visit buildings in cities, while they are being erected, was master of the information contained in this book, we should hear less about faulty and scamped building construction. The selection and arrangement of material is admirable and cannot fail to be very useful for the purpose for which it is intended.

INFINITESIMAL ANALYSIS. Vol. I. Elementary: Real Variables. By W. B. Smith. New York: Macmillan Company. 1898. Pp. 352. 8vo. Price $3.25.

The author is professor of mathematics in Tulane University, and this book is the result of ten years' experience in teaching the calculus. The aim has been, at a prescribed expense of time and energy, to penetrate as far as possible and in as many directions into the subject in hand, so that the student should attain as wide knowledge of the matter, and as full a comprehension of the methods, and as clear a consciousness of the spirit and power of this analysis, as the nature of the case will admit.

RESIDENTIAL SITES AND ENVIRONMENTS. Their Conveniences, Gardens, Parks, Painting, etc. By Joseph Forsyth Johnson. New York: A. T. De la Mare Printing and Publishing Company, Limited. 1898. Pp. 118. Price $2.50.

The author is a consulting landscape gardener and garden architect, and the entire work shows the hand of the expert. In the beginning the residential sites are considered and various sizes and arrangements of properties are shown. Special treatment is needed for broad views, another for long views and still another for waterside property, etc.; then come examples of model grounds, parks, homes, then chapters on the beauties of plant life, planting, and introduction to undulation, transplanting trees and large plants, natural grouping, rockeries, aquatic and bog gardens, public grounds, etc. All those who have property which they think of improving should possess the present work, which is rather unique. The book is handsomely printed.

BICYCLE REPAIRING. By S. D. V. Burr. New York: David Williams & Company. 1898. Pp. 208. 8vo. Price $1.

Some two years ago we noticed the first edition of this book. Since that time a large number of illustrations and much additional matter has been added, but the popular price has been maintained. There is hardly any one who has any taste for mechanics or who is fond of a bicycle who would not be interested in this book. It is filled with most practical suggestions, and we do not see how any repair man, no matter how poor his business, could afford to be without this book. It is profusely illustrated with clear and practical drawings which treat of everything from brazing to repair tags. We are pleased to note that four editions of the book have appeared.

DAS ALTER DER WELT. Auf mechanisch-astronomischer Grundlage Berechnet von Sigmund Wellisch. Vienna: A. Hartleben. 1898. Pp. 80. 8vo. Price, paper, 75 cents.

Since man first awakened to a consciousness of his willing and thinking power, he has endeavored to ascertain the time when all things had their origin. From the oldest biblical traditions down to the most recent investigations in the various branches of science, traces of this effort may be found. To-day, the determination of the age of man and of the world on which he resides, has become an important scientific problem. Beginning with laws purely mechanical and astronomical in nature, the author of this little pamphlet has attempted to reckon the age of the planets, the period when the earth was formed, and the time when man first made his appearance. The author accepts the Kant-Laplace theory of the origin of celestial bodies, and with this as a starting point, he has endeavored to subject Nature's work to a searching, mathematical investigation. From the laws of the increase of density of a cosmic mass subjected to a cooling action, the time is first calculated in which a celestial body passes from an attenuated gas into a solid body. Further geological and astronomical investigations finally lead the author to the conclusion that 1,020,000 years ago man first appeared on the earth; that the pre-geological period of the earth's history extends through 7,055,300 years, and that 9,108,300 years ago our earth emerged from primeval chaos and took its place in the universe.

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Minerals sent for examination should be distinctly marked or labeled.

(7505) W. R. B. asks: Will you kindly inform me whether in any of our modern breech-loading cannon the rifling makes more than three-fourths of a complete turn? A. The 10-inch rifle, of 35 calibers, makes one turn in 25 calibers. The 6-inch 30-caliber gun makes one turn in 25 calibers.

(7506) F. N. B. writes: We write you in regard to making a metal polish in liquid form. We have the powder and naphtha and want something that will dissolve in naphtha and hold it together. The powder and naphtha separate too quickly. Can you help us out? A. The following is the only formula we can find in our book of receipts for a metal polish in liquid form. Dissolve 15 parts of oxalic acid in 120 parts of boiling water and add 500 parts of pulverized pumice stone, 7 parts of oil of turpentine, 60 parts of soft soap and 65 parts of any kind of fat oil. You might try using naphtha in place of oil; make up the formula, using parts by weight. You can make up a small quantity at first and see if it works in a satisfactory manner. If you will tell us what ingredients you are using, we may be able to assist you further. Give full address.

(7507) L. T. asks: Which is theoretically the higher of two notes such as G sharp and A flat? Also how do you define, say, G sharp in an untempered scale? A. In an untempered scale G sharp is lower in pitch than A flat. To find the sharp of any tone, multiply its vibration number by $\frac{24}{25}$. To find the flat of any tone, multiply its vibration number by $\frac{25}{24}$.

(7508) I. H. A. writes: In reading your paper, the SCIENTIFIC AMERICAN, I noticed you furnish information to those requesting same. Therefore, if you can, please give a receipt for making Worcestershire sauce as near Lea & Perrins as possible, and will keep in any climate, also complying with the pure food law of the State of Wisconsin. A. This is quite a complex condiment. It is made of wine vinegar, 1½ gallons; walnut catsup, 1 gallon; mushroom catsup, 1 gallon; Madeira wine, ½ gallon; Canton soy, ⅛ gallon; moist sugar, 2½ pounds; salt, 19 ounces; powdered capsicum, 3 ounces; pimento, 1½ ounces; coriander, 1½ ounces; chetney, 1½ ounces; cloves, ¾ ounce; mace, ¾ ounce; cinnamon, ¾ ounce; asafetida, 6½ drachms; dissolve in 1 pint brandy 20° above proof. Boil 2 pounds hog's liver for 12 hours in 1 gallon of water, add water continually so as to keep up the quantity of 1 gallon; mix the boiled liver thoroughly with the water, strain through a coarse sieve, and add this to the above mixture.

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