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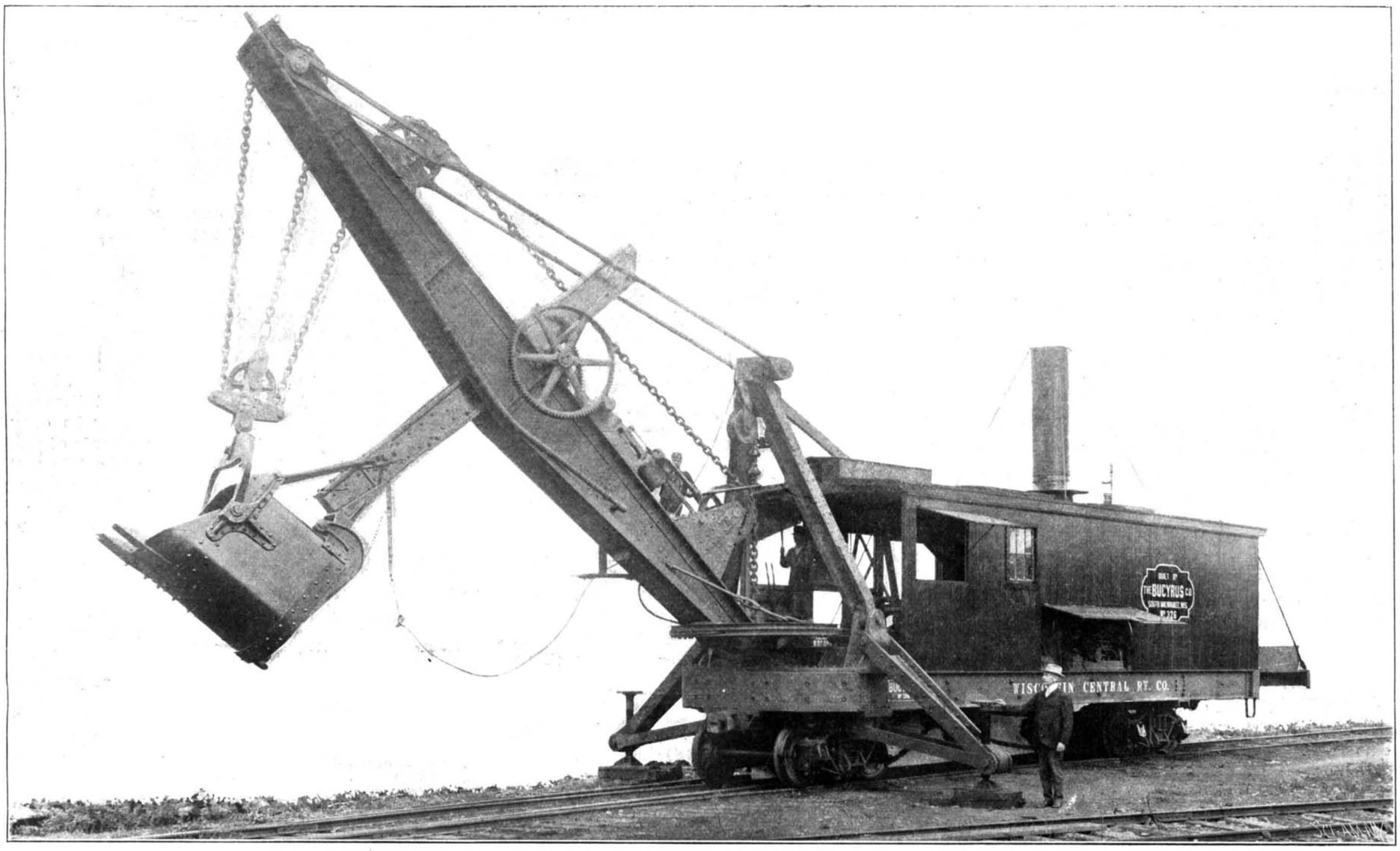
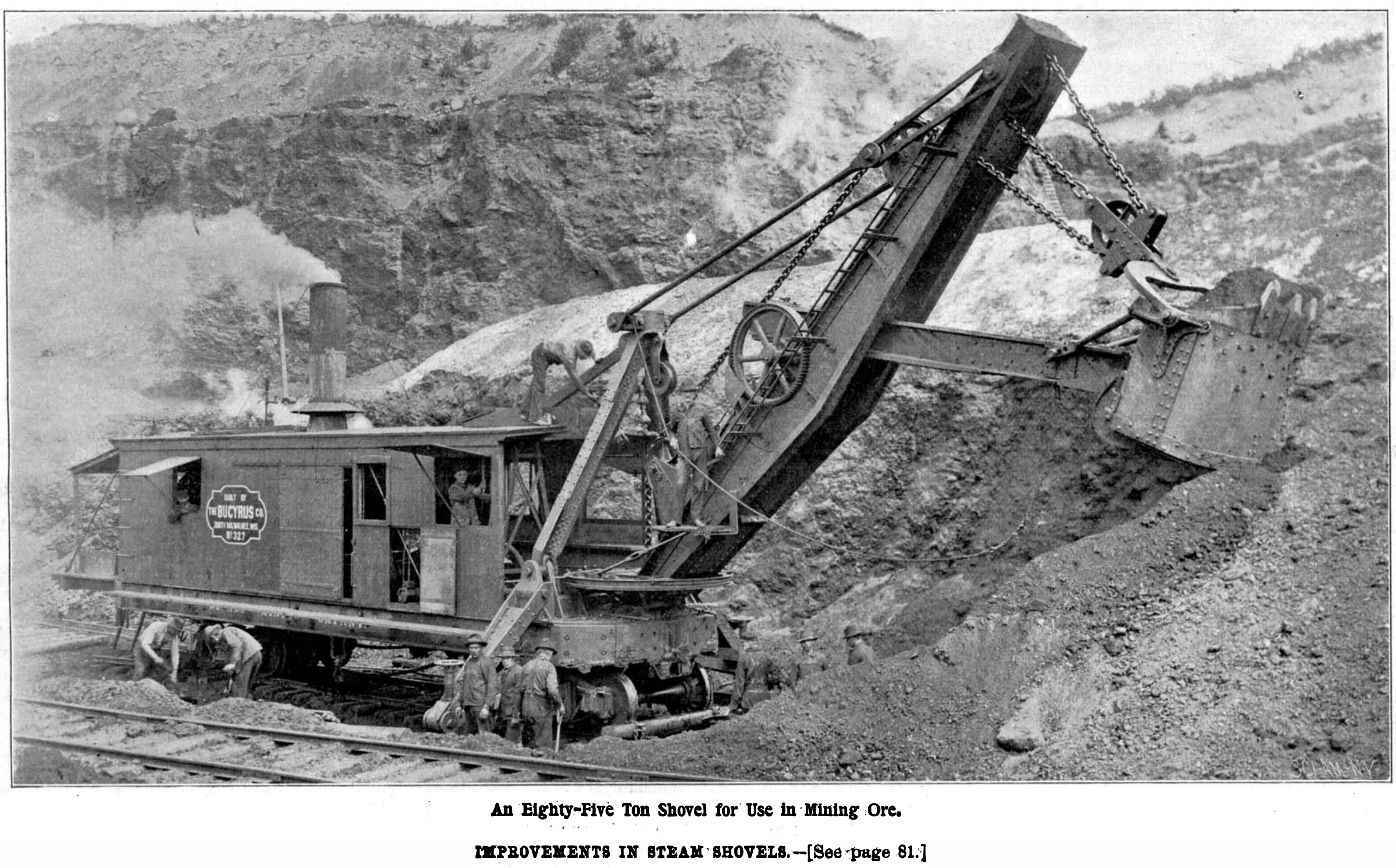


A New Ninety-Five Ton Shovel.



An Eighty-Five Ton Shovel for Use in Mining Ore.

IMPROVEMENTS IN STEAM SHOVELS.—[See page 81.]

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, AUGUST 1, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE TORPEDO TUBE AND OUR NEW BATTLESHIPS.

If one were asked to name the most distinctive characteristic of the American warship, he would be safe in referring to its great battery power; and this is true, whatever page of the brilliant naval history of this country we turn to. When an American ship has cast loose for action against a ship of equal size, she has usually had the fight well in hand from the very start of it, and this for the good reason that she has carried on her decks a battery more powerful both in numbers and in power and excellence of the individual pieces. That the policy has been a wise one, is proved by the record of our naval victories; and while the successes were gained chiefly in the days of sailing frigates, wooden hulls and smoothbore guns (the naval actions of the Spanish war were too one-sided to have any bearing upon the question) it is the confident belief of the United States navy that in any future war the exceptional weight of our batteries may well prove to be the deciding factor.

The designs for our latest battleships, however, of the "Louisiana" and "Connecticut" class, are marked by an omission of one of the most effective offensive elements of the modern warship, an omission which may be considered so serious that it is questionable whether these ships, large, swift, and powerful as they are, can be reckoned as strictly first-class. We refer to the fact that no provision whatever has been made for the installation of torpedo tubes, and this at a time when the latest ships of the foreign powers are using, in large numbers, a torpedo which in range and accuracy is enormously superior to the torpedo carried at the time of the Spanish war. The reason for omitting the torpedo from our new warships is to be found in the disastrous behavior of this weapon in the two last naval wars—that between China and Japan and our own Spanish war of a few years later. In each war there were instances of vessels being destroyed by the explosion of their own torpedoes, "hoist with their own petard," and evidently it was considered by our Bureau of Construction that the risks to the ship that carried this weapon were so great as to offset the rare occasions on which it might be used to good effect against the enemy. The omission of torpedoes from our ships because of these considerations, would have been justified were it not that the risk of self-destruction has been removed by the perfecting of the under-water torpedo-launching device, which renders it possible to carry the torpedo at all times below the water-line, and therefore below the protective deck, where it is secure from the enemy's shell fire. Contemporaneously with the development of the under-water discharge tube, there has been a remarkable improvement, thanks to the invention of the gyroscopic steering gear, in the torpedo itself, so that torpedo range is to-day extended to from 1,500 to 3,000 yards or more. It is a fact that instead of the modern torpedo constituting a frightful element of danger to the ship that carries it, the risk to the user has been entirely eliminated, and the weapon is perhaps the most deadly element in the armament of a modern warship. So important has the under-water torpedo become, that it is certain to exercise a more powerful modifying effect upon the tactics of a future naval battle than any other element, whether of speed, armor, gunfire, or maneuvering power, in the modern fighting ship. Clear proof of this was given in the series of naval war games recently played at Portsmouth between two parties of British naval officers representing the American and German navies, and published in the Scientific American Supplement. In several of the engagements of this war, the absence or comparative absence of torpedoes from American ships, and the ample supply carried by the Germans, proved to be the controlling factor, not merely in the tactics as laid down or followed by the opposing fleets, but also in the actual stress of the battle itself, more ships being lost and more battles won by the under-water torpedo than by any other element. The under-water torpedo is not merely a weapon of enormous offensive power, but it is equally valuable for defense. If a ship having no torpedoes be disabled, say by derangement of her steering gear, she becomes an object of easy attack by a much less powerful vessel carrying torpedoes, for the larger vessel being unable to maneuver, her enemy can approach her from the quarter in which she herself will be least exposed to gunfire, and when she is within torpedo range, can sink her powerful but helpless enemy with deliberation. On the other hand, should the disabled vessel possess an armament of four or five well-distributed torpedo tubes, she would possess sufficient power of retaliation, even if her batteries were silenced, to prevent any ship of the enemy from attempting to use the ram.

In view of the most serious nature of this omission from the "Louisiana" and "Connecticut," it is a question well worth considering as to whether, at this early stage of the construction of the hulls of these ships, it would not be well to make such changes as would admit of installing at least four broadside torpedo tubes below the water-line. Each installation would not weigh more than 35 tons—say about 140 tons for the four. If it should prove difficult to allot the necessary weight and space, the vessels could well afford to sacrifice some of their enormous battery power above water in order to gain an under-water battery whose actual and moral effect would be of far greater value. If anything is to be done, it should be done quickly, and if the change be not made at once, we venture to say that it will be a cause of lasting regret to every officer who may be called upon to command these two magnificent ships.

ELECTROCHEMICAL DISCOVERIES.

The group of industrial establishments that have grown up around Niagara in the past few years to delve deeper into the mysteries of electrochemistry, are rapidly transforming many lines of business and trade manufacturing. The supply of electric power in large units has primarily been responsible for this marvelous growth; but purely experimental companies are now carrying on exhaustive tests and experiments to develop new industries for the benefit of mankind, and their work is receiving critical attention from all parts of the world.

Industrial electrochemistry and electrometallurgy have already accomplished wonders in the field of manufacture. Carborundum has become a staple product of the electric furnace, displacing in many trades nearly all other abrasive materials. In the past year it has become an important factor in the steel trade, and some seventy-five tons per month are demanded for this industry alone. More recently tungsten and ferro-tungsten have been satisfactorily produced in the electric furnace, and the use of these in the steel trade for manufacturing self-hardening and high-speed tools has steadily increased.

The manufacture of aluminium, zinc, and manganese in the electric furnace has also achieved considerable importance, and promises for the near future far-reaching developments. There are several factories now engaged in manufacturing aluminium at Niagara Falls and Massena, and their total output is considerable. Commercial phosphorus is satisfactorily made by mixing the finely-powdered phosphate material with carbon and sand in the electric furnace, and then, when heated, distilling the phosphorus from the mass, and collecting it under water.

The development of the carborundum industry led to the manufacture of artificial graphite, which is now produced by passing the amorphous carbon through the electric furnace, and obtaining a pure graphite with merely a fraction of one per cent of ash. Even the direct graphitization of anthracite coals has been successfully accomplished, a granular graphite being obtained which can be extensively used for lubricating purposes. This graphite is easily manipulated with machine tools, and is of great service in many trades. In 1901 over two million pounds of this graphite were made in this country, and much more in the year just closed.

The electrolytic production of caustic alkalies and chlorine has proved of the greatest importance to the world of trade. The chlorine produced is used for making bleaching powders, which in turn has revolutionized the bleaching trade here and abroad. The production of sodium by electrolyzing fused caustic soda has developed rapidly at Niagara and other places where large electric units are supplied at low rates. The production of sodium is now conducted on a large scale.

The application of the electric furnace to steel manufacturing has also received a good deal of attention in France and by the Niagara people. Experiments have been conducted to manufacture steel from pig iron in the electric furnace, and also to smelt the ores directly and manufacture and refine the material in two connected furnaces. At St. Etienne, France, iron ore has been treated most successfully in specially-prepared electric furnaces, and new factories are being projected for carrying the work forward on a commercial scale.

The manufacture of carbon bisulphide by directly treating in the electric furnace charcoal and sulphur is now in operation at Penn Yan, N. Y., where a daily output of 10,000 pounds is an average. The electric furnaces employed for this work at the Penn Yan factory represent the largest yet made in any of the electrochemical industries in this country. They are sixteen feet in diameter and about forty feet high, having a capacity sufficient to make a larger daily output than any similar factory in the world.

The production of nitric acid by electrochemical methods is a new process that promises extensive changes in our agriculture. The manufacture of nitric acid from the nitrogen and oxygen of the air in sufficient quantities for commercial uses has been the dream and hope of scientists for years. At Niagara experiments have been conducted successfully in producing commercial nitric acid by using a high-tension current in an air chamber, by which a yield of one pound of nitric acid is obtained for every seven horse-power-hours. Steps are now being taken to establish the production of nitric acid on a large commercial scale, and while further experiments in this field will be conducted, they will be simultaneous with the practical work of making the product.

So remarkable have these and similar industries become, that purely experimental companies have been formed within the past year to investigate further in electrochemistry at Niagara for the sole purpose of discovering new processes to patent. They do not intend to establish any commercial factories, but to dispose of the rights to their patents and discoveries to industrial companies which can easily be organized later. They represent the modern wizards of practical chemistry, seeking new discoveries in a field that has already proved exceedingly rich. The experts who compose these experimental companies are searching for definite results along lines already indicated by past successes. Starch, for instance, is receiving considerable attention from the electrochemists, and it is believed that this will soon be produced by some electric process. Likewise artificial rubber is a substance that is attracting the ambitious, and results already obtained justify the chemists in continuing their experiments with this object in view. The recent scare in prices of good rubber, and the lessening supply of crude rubber, stimulate the workmen to greater effort in the field of electrochemical experiment.

There are many other lists or groups of products of great commercial value which the experimenters are trying hard to produce artificially by chemical reactions with the high temperature electric furnace and current. Ammonia, cyanides, and silicides are among the most promising of these, although not by any means the only ones. The manufacture of artificial camphor is now assured, and calcium carbide is now produced on an enormous scale. One company converts barium sulphate into other needed barium salts. Barium hydrate is now produced so successfully that its price enables the different trades to use it in many minor ways. Both the sugar and paint trade—two widely distinct industries otherwise—employ barium hydrate on a large scale.

One important feature of all these new industries is the stimulating effect they have upon widely separated trades and manufacturing industries. By producing materials on a large commercial scale, they enable other trades to utilize them in ways never before considered possible. With the cheapening of the products their use becomes universal. They have thus directly tended toward lessening the cost of production of articles in common use. Synthetic electrochemistry is thus proving in its quiet way one of the greatest trade revolutionizing factors the world has ever known. The unlocking of secrets by man's ingenuity is always fascinating and stimulating, but when they in addition help mankind by placing within the means of everybody articles which were formerly considered luxuries, the result is something that holds the admiration of all. From Niagara, Massena, Penn Yan, and other places where large electrical units are easily obtained, the world of science and trade hope for revelations that more than rival the visionary acts of mythical wizards of old.

NORDENSKIOLD'S SHIP CRUSHED IN THE ICE PACK.

The whaler "Vega," in which Nordenskiold went through the Northeast passage, was crushed and sank in Melville Bay, on May 31. After a difficult journey of 300 miles in open boats across the ice, the crew reached the nearest settlement, and returned home. No lives were lost. The "Vega" was a steam whaler bought for the expedition. She was built in the years 1872-3 at Bremen, of oak, with an ice skin of greenheart. She was rated at 299 register tons, loading about 500, was 150 feet in length, breadth of 29 feet, and depth of 16 feet. She was fully rigged as a bark and was considered a good sailer. Her crew consisted of eighteen seamen of the Swedish navy and three Norwegian walrus hunters. She was provisioned for two years. After passing East Cape, Behring Strait, July 20, 1879, the "Vega," on September 2, arrived at Yokohama and returned to Sweden after circumnavigating the globe.

THE HEAVENS IN AUGUST, 1903.

BY HENRY NORRIS RUSSELL, PH.D.

We are abundantly favored with evening views of the planets at present. Venus and Mars light up the west after sunset, and, as they disappear, Saturn and Jupiter arise to take their places. Uranus is also in sight, but is not conspicuous.

At 9 P. M. on the 15th, Venus has not long set. Mars will soon follow her, but he is still a few degrees above the western horizon. The most conspicuous star in the western sky is Arcturus, which is about half-way down from the zenith.

Far to the southward, beyond Ophiuchus and Serpens, is Scorpio, still well visible just past the meridian, while Sagittarius is farther east.

Following up the Milky Way from these constellations, we first reach Aquila, after a vacant region. Then come Cygnus and Lyra, the latter almost directly overhead.

The great square of Pegasus is the most conspicuous configuration in the eastern sky. To the north of it are Andromeda and Perseus, just rising, and to the south are Aquarius and Capricornus, themselves inconspicuous, but now rendered bright by the presence of Jupiter and Saturn.

Cassiopeia is on the right of the pole, Draco almost above it, and Ursa Major on the left.

Hercules and Corona, which lie between Vega and Arcturus, complete the list of conspicuous constellations now visible.

THE PLANETS.

Mercury is evening star throughout August, but will not be easy to see, as he is too far south of the sun. Even at the end of the month, when he is farthest from the sun, he sets but 40 minutes later. On the 28th he is in conjunction with Venus, but the two planets are far apart—more than six degrees—and too near the sun to be well seen.

Venus is also evening star, and is conspicuous during the earlier part of the month, reaching her greatest brilliancy on the 12th. But as she is now rapidly swinging into line between the earth and the sun, she sets earlier and earlier from night to night, and by the end of the month she will be hard to see. Her apparent motion among the stars is small, and she remains in Virgo, about midway between Spica and Regulus, throughout the month. On the 1st she sets at about 9 o'clock, but on the 31st she disappears before seven.

Viewed with the telescope, she appears as a crescent, which steadily narrows as the month advances, the illuminated portion of her disk varying from one-third on the first to one-tenth on the 31st. In her present position, Venus appears larger with the same magnifying power than any other planet ever does, and it is easy to see the crescent phase with any powerful field-glass, that is, one which magnifies six or eight diameters. Even with an instrument of half this power, the crescent phase can be detected by a trained eye.

Mars is evening star in Virgo and Libra. On the 1st he is not far from Spica, and sets at about 10:10 P. M., but at the end of the month he vanishes an hour later.

On the 29th he passes south of the third-magnitude star Alpha Libræ, at a distance of about 1½ deg. The two objects will afford a pretty field for a low-power glass, as the star in question is a wide double, whose companion is just too faint, and too near its primary, to be seen with the naked eye.

Jupiter is on the borders of Aquarius and Pisces, and is rapidly becoming conspicuous in the evening. At the beginning of August he rises at about 9:15, and a month later at 7:15. He can be instantly recognized by his brightness, which far exceeds that of any of the fixed stars.

Transits of his satellites, interesting to watch with good telescopes, occur before midnight on the evenings of the 7th, 14th, 16th, 23d, and 30th. The 16th is a particularly interesting night, as all four satellites take part in the performance, though not all at the same time.

Saturn is in Capricornus, and is visible all night long, passing the meridian at a little before 11 P. M. on the 15th. Though very far south, he is a fine telescopic object.

Those who have been following his aspect for the last few years will notice a change in the appearance of his rings. Two or three years ago, the elliptical outline of the rings was unbroken by the planet, but now the ellipse has narrowed so much that the ball of the planet projects beyond it on both sides.

This is an effect of perspective, due to the fact that we now see the rings more nearly edgewise than we did in 1900. The rings will appear to narrow with increasing rapidity until 1907, when they will actually present their edges to us, and vanish from view except in the most powerful telescopes. Then they will open out again, but we will see the southern face of the rings, instead of the northern one, as at present. This disappearance of the rings was a great puzzle to the earlier astronomers, and it was a long time before the true explanation of the apparently discordant observations made at different epochs was discovered. But this discovery opened the way for an even more perplexing question. How did the rings get there, and how do they continue to stay there, consistently with the law of gravitation? The subject has occupied the attention of many distinguished mathematicians, and one theory after another had to be abandoned, till at last a fairly satisfactory one was found.

If the rings were solid, calculation shows that if they were not enormously stronger than any known substance, they would be torn to pieces by the enormous forces set up by the attraction of Saturn itself. Moreover, it has been further shown that, even if a sufficiently strong substance could be found, the motion of a solid ring would not be stable. It would resemble the condition of an egg balanced on its small end. So long as the egg is left alone, it will continue to stand in this position; but the slightest jar will cause it to fall over. Similarly, a solid ring of Saturn, if it was started right, might go on indefinitely; but at the slightest disturbance by any outside force, it would deviate more and more from its original position, until it finally came into collision with the other rings or the planet, and destroyed the whole system.

As the attraction of the satellites of Saturn affords just such a disturbing force, it is clear that the permanent existence of the ring proves that it cannot be solid.

It has indeed been shown by Prof. Clerk-Maxwell that the rings might be stable if they were loaded with heavy masses at certain points. But when the rings are seen edgewise, they show a smooth and even line, which grows all the more uniform as the power of the telescope and the steadiness of the air increase. So this theory must also be given up.

After proving that a liquid ring would in like manner break up into pieces, Maxwell showed that a stable system could be found. According to his theory, the rings of Saturn consist of a multitude of small particles, each of which revolves about the planet in a practically circular orbit, almost as if the others were not there. They are so close together that we cannot see them separately, and the whole mass of them is opaque (like an ordinary cloud). He proved that under these circumstances, if the particles were small enough, their motion would be stable. Such a system would behave like an egg lying on its side. A small disturbance only causes it to oscillate about its former position.

Maxwell's theory of the rings has since received several striking confirmations. To begin with, the innermost of the rings (the so-called "crape ring") is transparent, and the planet can be seen through it. This can be explained by supposing that the particles of which it is composed are so far apart that we can see through between them.

Certain peculiarities in the way in which the rings reflect varying amounts of light at different angles of incidence can also be explained satisfactorily on this theory, and on no other.

But the most striking proof of all was first obtained at the Lick Observatory by the late Prof. Keeler, who applied the spectroscope to determine the motion of the rings in the line of sight.

If the ring rotates like a solid body, its outer edge must move faster (more miles per second) than the inner. But on Maxwell's theory the reverse would be the case, as the inner particles, like the inner planets of the solar system, would move faster than the outer ones. Prof. Keeler's photographs show that this is actually the case, and are by themselves sufficient to prove that the ring is made up of innumerable pieces.

How the rings came to be formed is a still more difficult problem. But it is interesting to notice that it has been shown that a satellite of any size, revolving as near the planet as Saturn's rings are, would be torn to bits by the tidal forces due to the planet. It is therefore not unnatural to regard the rings of Saturn as representing one or more satellites spoiled in the making—broken apart by tidal forces (or prevented from ever gathering together) and spread out by the action of these same forces into the thin, flat sheet that we see.

Uranus is evening star in Ophiuchus. His position on the 15th is in right ascension 17h. 24m., declination 23 deg. 29 min. south—about 1½ deg. north and 2 deg. east of the third-magnitude star Theta Ophiuchi. He comes to the meridian a little before 8 P. M. and is just visible to the naked eye.

Neptune is in Gemini, and rises about 2 A. M. on the 15th.

THE MOON.

Full moon occurs at 4 A. M. on the 8th, last quarter at midnight on the 15th, new moon at 3 P. M. on the 22d, and first quarter at the same hour on the 29th. The moon is nearest us on the 21st, and farthest away on the 6th.

She is in conjunction with Uranus on the 3d, Saturn on the 7th, Jupiter on the 11th, Neptune on the 19th, Mercury and Venus on the 24th, Mars on the 27th, and Uranus again on the 30th. None of the visible conjunctions is close.

BORELLY'S COMET.

Photographs of the region of Borelly's comet, 1903, G, were taken at the Harvard College observatory on May 28, 1903, at 19h. 45m. G. M. T., and May 30, at 19h. 52m. G. M. T., about three weeks before its discovery. The positions of the comet at these times were for 1855, R. A. 21h. 49m. 27s., Dec. —19 deg. 6.1m.; and R. A. 21h. 50m. 15s., Dec. —18 deg. 33.2 m., according to the observations of Fayat. Astron. Nach., 162, 291. In both cases, the position of the comet was near the edge of the plate. An object closely resembling the comet was found on the first plate in R. A. 21h. 48m. 43s., Dec. —19 deg. 16.8 min., and of about the magnitude of the stars —19 deg. 6193 and —19 deg. 6198. These stars appeared on the second plate, but no image of the comet was found in the corresponding position. Its computed brightness on these dates should have been about one-sixth of that at the time of discovery. It was therefore probably too faint to appear on these plates, but that cannot be determined with certainty until more accurate elements have been computed. Plates covering the region of the comet were also obtained at Arequipa on May 14 and May 29, and probably on May 4, 1903, but they have not yet been received in Cambridge.

EDWARD C. PICKERING.

WHITE SPOT ON SATURN.

On July 1, after observing Jupiter for some time, I directed my 10-inch reflector to Saturn, and found the details sharply defined. The dusky north polar cap was very distinct, and so was the dark belt on the north side of the equator. The belt was darkest and more strongly outlined on its southern side, probably by contrast with the bright equatorial zone. I soon noticed a large bright spot on the north side of the belt, and in a position nearing the western limb of the planet. It was followed by a diffused dusky marking. The luminous spot must have been on the planet's central meridian at about 14h. 1m., but this is only a rough estimate, as the marking was far past transit when I first saw it. It is to be hoped that this feature will prove fairly durable, in which case it may be expected to furnish an excellent means of redetermining the rotation period of Saturn.

A telegram from Kiel which has been widely published, states that Barnard, of the Yerkes Observatory, saw a white spot in Saturn's N. hemisphere central on June 23, 15h. 47.8m. Williams Bay time. Allowing for the difference of longitude, this would be 21h. 42m. G. M. T. Adding eighteen rotations of Saturn of about 10h. 14m. will bring us to the time when the spot was approximately in transit as observed at Bristol, and there seems no doubt as to the identity of the objects.

This disturbance on Saturn will recall Prof. Asaph Hall's white spot seen in the winter of 1876-7, and followed from December 7 to January 2. A number of transits of this object were observed by Hall, Eastman, Newcomb, Edgecomb, and A. G. Clark, and from the data obtained the former found the rotation period of Saturn to be 10h. 14m. 23.8s. ± 2.30s. mean time.

The spot lengthened out into a bright belt, and soon lost its distinctive character.

Should the present object remain visible, it will be on or near the central meridian of Saturn on July 10, 13h., July 13, 12½h., and July 16, 12h. 10m.—W. F. Denning, in Nature.

The problem of piercing a glacier by means of boring has at last been solved, says the New York Sun, with results of real scientific interest in experiments made last August on a glacier near Vent, in the Tyrol. At a distance of about one and a quarter miles from the tip of the glacier where its breadth is 2,130 feet and the height of its surface above sea level 8,530 feet, a boring in the middle reached rock at a depth of 500 feet. Taken along with measurements of rate of movement, surface melting and temperature the experiment enabled the following conclusions to be drawn: First—the temperature of the ice is at the melting point throughout the whole mass on the tongue of the glacier. Second—the bed of the glacier is trough-shaped. Third—the ice moves more slowly at the bottom than at the surface. The bore holes were filled up with pieces of wood, which will serve for many years to come as indexes of the rate of movement and of surface melting.

AN IMPROVED TYPE OF STEAM NOZZLE.

A patent recently obtained by Mr. William S. Clarkson, of Livingston, Mont., covers a new form of steam nozzle, particularly adapted to be used in the smoke-box of a locomotive, for the purpose of utilizing the exhaust steam from the engine to increase the draft upwardly through the smoke-stack. The construction of the steam nozzle is very simple, the device can be very cheaply manufactured, and it possesses the capacity for long and repeated service. It comprises a cluster of tubes of circular, or, preferably, of quadrilateral cross-section, annularly arranged upon a base plate adapted to fit onto the upper end of the exhaust pipe of the locomotive. The center opening formed by the cluster of tubes is closed by a hollow inverted cone, which serves as a spreader to direct the exhaust steam into the annularly disposed tubes. It will be observed that the tubes are tapered so as to form radial channels leading into the center opening above the spreader cone. In operation, the exhaust steam being deflected laterally by the spreader cone, rises through the tubes and emerges from the nozzle in the form of a ring. The steam in rising induces currents of gases within the smoke-box, to pass inwardly into the radial channels to the center of the ring of steam, thereby increasing greatly the effectiveness of the nozzle. It will be observed that the nozzle permits the use of an exhaust pipe of large cross-section, and also smoke-stacks of larger area than hitherto, allowing greater volume of gases to be discharged without increasing the force of gas. In virtue of the conical spreader being hollow, a constant eddy of gases is maintained, which also greatly facilitates the operation of the device.

THE EDEM FOG SIGNAL.

During fog and mist, vessels are exposed to collisions and experience great difficulty in entering harbors. A new fog signal invented by a Belgian, Mr. E. de Meulemeester, is designed to prevent these dangers. The apparatus consists of (1) a receiver of the waves of sound and (2) an indicator of the source of emission of the sounds.

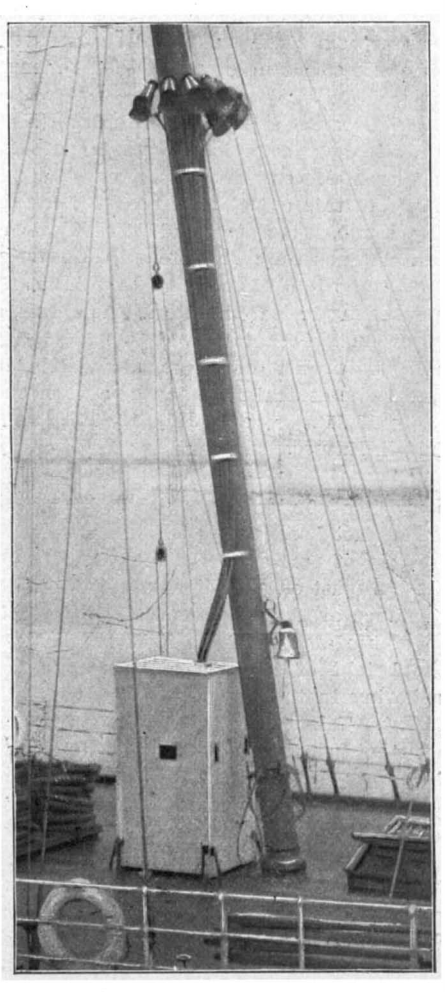
The receiver consists of a series of trumpets arranged in a circle on a mast, with their bells turning to all points of the horizon, the narrow end of each of these trumpets being connected to the indicator by means of a tube.

The indicator, close to the hand of the captain or of the officer of the watch, has a tubular ring, from which issue all the acoustic tubes from the receiver, the orifices being fixed round the ring in order corresponding to the position of the trumpets of the receiver. In this tubular ring is a small opening, to which is attached a hearing tube, by means of which sounds entering the trumpets are heard by the person working the instrument. Each of the acoustic tubes is furnished with a valve or "interrupter" near the orifice, the closing of which intercepts the passage of sound; besides which, the interrupters are supplied with a mechanism enabling the operator to open or close the valves at will. Around the ring of the indicator are marked numbers in an order corresponding with those of the trumpets of the receiver. A movable index needle completes the mechanism. By means of a special arrangement, the officer of the watch can perceive the sounds received by the indicator directly and at the same moment as the operator, and so control his work.

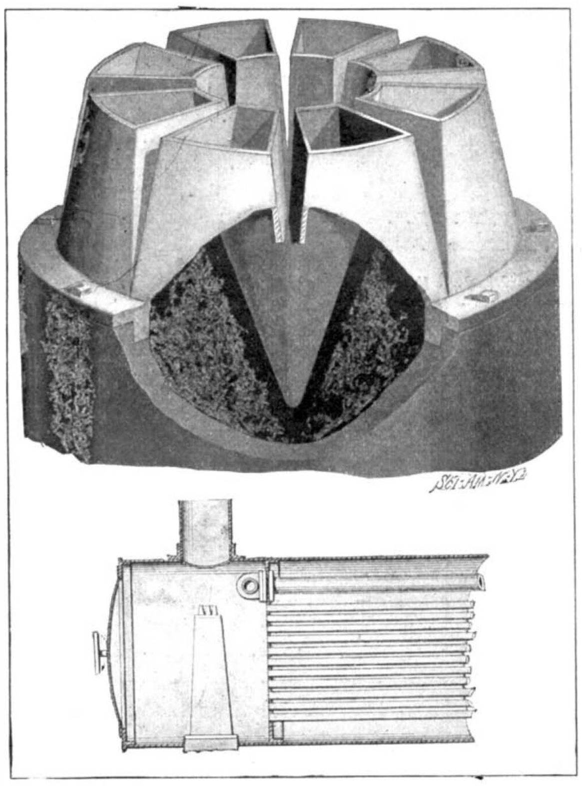
When the operator hears a sound coming from some point of the horizon, by means of the mechanism at his hand, he closes all the acoustic tubes passing from the receiver to the indicator, except the one in front of the index needle. If then he hears nothing, it signifies that the sound does not proceed from the direction toward which the bell of the trumpet, corresponding to the open tube, is turned. He then places the index between two tubes (by which means all the tubes are opened again) and notices whether the sound continues, after which he sets the index at the following number, and so on till he discovers the exact direction of the sound. The whole proceeding takes but a few seconds.

The Edem fog signal, through its rapidity and the exactitude of its signals, indicates immediately to captains of vessels supplied with the necessary appliances their position and their respective courses during fog, so that hesitancy and inaccurate maneuvers liable to bring about a collision are avoided. The signal offers the captain of a vessel facility in finding the entrance of a harbor.

Experiments have been made in the North Sea with two steamers, one furnished with the fog signal and the other without it. The last was ordered to give signals with its siren, maneuvering now at port, now at starboard, passing in front and behind the other steamer. The operator of the first ship could always indicate the position of the other ship in a few seconds by means of the indicator's needle, and follow the alterations of its course. The experiments have proved that one can locate the source of the emission of the sounds in a space of a twelfth of the horizon. By the difference in the intensity of the sound, the approach or retreat of a ship can be indicated.



THE EDEM FOG SIGNAL.



STEAM NOZZLE FOR LOCOMOTIVES.

Cork.

The item of corkage in the bottling of the finer wines is one of the most important details. Only the most select corks, free from brown blemishes and airholes, are used; the common corks being employed for the bottling of cheaper products. Practically all of the corks used in the world are grown in the Mediterranean countries, where it is estimated that between three and four million acres are planted to cork oaks. It would seem as though the cork oak industry in the United States might claim the attention of practical men who favor the production of necessities at home rather than the sending of money abroad for them. An effort was made in 1858 to introduce the cork oak, and acorns were planted and distributed by the Department of Agriculture in California and various of the Southern States. The experiment was not, however, carried to a conclusion, and it is yet to be demonstrated whether there are varieties of this oak which will produce corks in the United States with profit. From occasional scattered specimens it would seem that the tree will grow and thrive in this country. The importations of cork into the United States have steadily increased during the last three or four years, until in the fiscal year ending June, 1902, they were the highest on record, being in round numbers $2,500,000. Prior to 1901 they had never passed the two million mark. During the past century cork has advanced over 1,000 per cent in value, the increase being caused by the more general use of bottles.—G. E. M.

"Spliced Rail."

In the effort to overcome the nuisance of the low joint in the construction and maintenance of railroad track, a "spliced rail" is being introduced to the railroad world, by the means of which a continuous rail is practically secured, yet one which it is readily possible to remove and renew at any time with no more difficulty than is experienced with the typical rails now in general use. This rail, which was patented only a few months ago, is of compound construction, consisting of three longitudinal sections. The ball, with downward-extending web portion, is one section, and the base, being divided, with upward-extending web portions, makes the other two sections. The sections being of equal length are bolted together so as to break joints or divide the old method of whole or butt joints into thirds, thereby making a spliced or continuous rail. Thus where the ends of the ball portion come together, making only a third of a joint, the base on either side is perfectly solid and prevents any up and down or hammering motion whatever. This rail is used in the same manner as the present T rail, and in laying the same allowance is made for the expansion of the metal. The parts are bolted together, and when this is done, the rail is laid in precisely the same manner as is the custom at present.

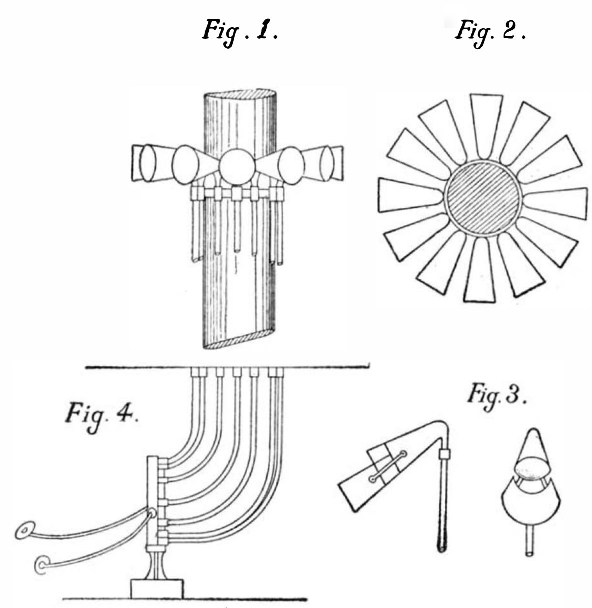


Fig. 1.—Collectors on mast. Fig. 2.—Plan view of collectors. Fig. 3.—Detail of collectors. Fig. 4.—The receiver.

PARTS OF THE EDEM FOG SIGNAL

THE RECEIVER.

AUTO CHAIRS FOR THE ST. LOUIS FAIR.

Automobile chairs propelled by electricity will be used at the World's Fair at St. Louis next year. A concession was recently granted by the Exposition to a St. Louis company, giving them the right to operate the new style chairs within the World's Fair grounds. The chair is the invention of Semple S. Scott and is the result of nearly three years' experimenting and designing.

It is said that the machine has a uniform speed of three miles an hour, which is exactly the same running up or down a steep grade or on a level. The occupant has no control over this speed whatever. The simplicity of operation is such that anyone can readily run it. The most desirable feature is the fact that the machine is provided with a sensitive guard rail. The latter is deemed the most valuable invention on the machine. If the machine collides with any object or person, a pressure of only a few ounces pushes this guard rail back and causes the wheels to become locked, thus bringing the chair to a dead stand-still before the machine itself strikes the object or person.

Each chair will carry two passengers, one of whom may operate the machine, or, if desired, an operator will be furnished, who will not only run the machine but will also serve as a guide to explain all the points of interest. The operator sits on a detachable seat at the rear of the chair, from which point he controls the machine, the controller and steering bar being removed from the front and attached to sockets in the rear.

AUTO CHAIRS FOR THE ST. LOUIS FAIR.

Mocha Coffee.

During the past few years I have often heard the assertion made and have seen it in the newspapers in our country that there was no such article as Mocha coffee, that the term is purely a fiction, and that what was once known as Mocha coffee is so mixed with other coffees that there is no real Mocha.

In order to help correct such an impression and to do the coffee merchants of this place and the importers of our country an act of justice, I wish to say that there is such an article to-day in the American market as Mocha coffee, that this coffee is of the same kind and from the same place as the noted Mocha coffee of several generations ago, and that the growers and handlers of this coffee are as particular in regard to its quality and purity as they ever were.

At different times merchants have tried to ship coffee from other countries to this place and forward it from here as genuine Mocha, but the city authorities have always suppressed such traffic and have otherwise assisted the merchants in keeping up the standard and good name of this coffee.

Knowing of the carefulness with which the coffee interest is managed and the government's protection over it, I am of the opinion that if by the time the consumer gets his Mocha coffee it is not pure, the mixing has been done after it leaves Aden.—W. M. Masterson, U. S. Consul at Aden.

Mr. Edison's dry gold separating process is to be used in Australia. Mr. Cloyd M. Chapman, a mining engineer, has had a separator built and shipped to Australia.

IMPROVEMENTS IN STEAM SHOVELS.

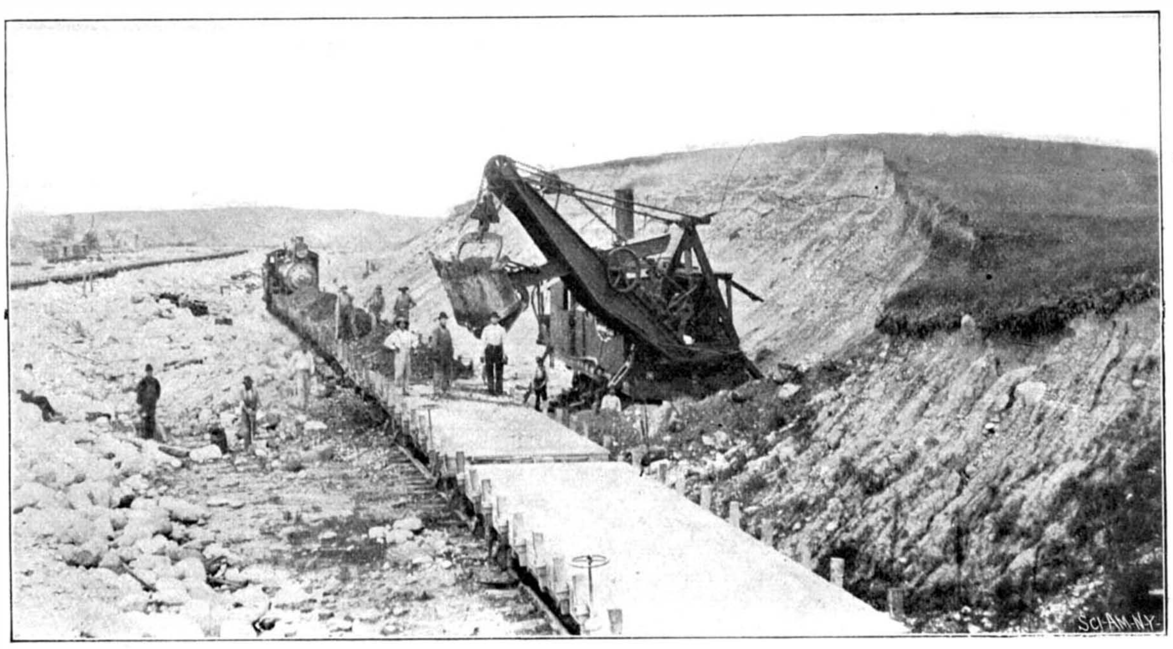
BY WALDON FAWCETT.

A most notable advance has been made within the past few years in steam-shovel construction—progress impelled in part by the greater exactions made upon these mechanical excavators by modern construction work. The 35 and 45-ton shovels were considered, until a comparatively short time since, amply sufficient for almost all kinds of excavations; but at present the 55-ton shovel is accounted the standard machine; and 65-ton, 75-ton, and 85-ton are coming into use to an increasing extent, while even the 95-ton giants are proving that they are not only useful but also economical for certain classes of work.

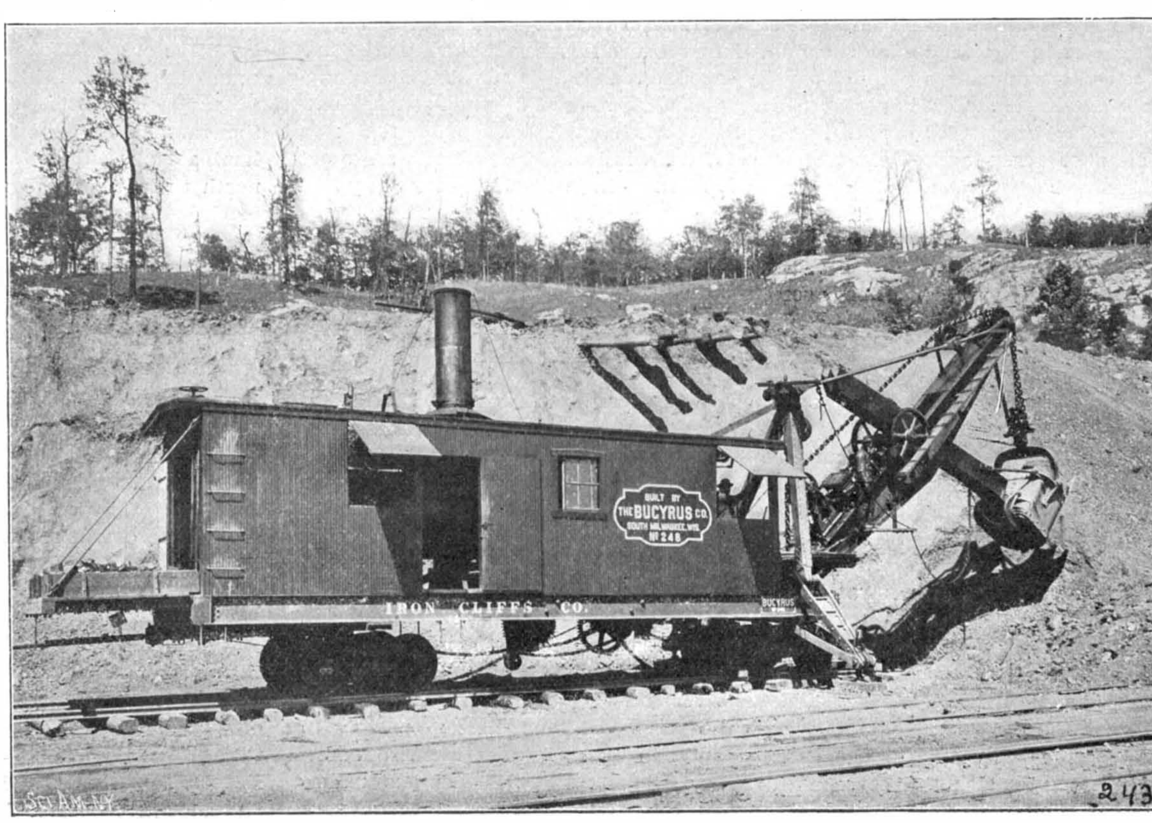
The true meaning of the increase in the capacities of steam shovels is best indicated by comparative statistics. Thus, while the clear lift from rail to bottom of dipper-door when open is but 10 feet in the case of the 35-ton shovel, it is 12 feet in the 55-ton shovel; 15 feet in the 65-ton machine; 17 feet in the 75-ton shovel; and 18 feet in the 85-ton apparatus. The width of the cut which, in the old-style, lighter-weight shovels, rarely exceeded 48 feet at 8-foot elevation, ranges from 50 to 54 feet in the case of the newer models. The steel car of 29½ feet in length, which serves as a foundation for the 35-ton shovel, appears rather insignificant beside the cars of 41 feet 7 inches, which bear the latest specimens of steam shovel construction.

The same proportionate advance is manifest in the case of the main engines, which have grown from the 8 x 10-inch size in the 35-ton shovel, to the 14 x 16-inch engines of the present day 95-ton shovel. Likewise the steam generators have shared in the new order of things, as will be appreciated by a comparison of the 48-inch diameter boiler of the 35-ton shovel, with the 66-inch diameter boiler which supplies steam to the machinery of the 95-ton shovel.

After all, however, the most significant phase of the development of the steam shovel is found in the enlargement of the capacity of the dipper, or, in other words, the increase in the actual working capacity, as indicated by the task accomplished. The capacities of the dippers of various representative shovels are as follows: 35-ton, 1½ cubic yards; 45-ton, 2 cubic yards; 55-ton, 2½ cubic yards; 65-ton, 3 cubic yards; 75-ton, 3½ cubic yards; 85-ton, 4 cubic yards; 95-ton, 5 cubic yards. Still other radical improvements might be noted, each important in its way. For instance, the type of thrust motion, which was the frictional in the old-style shovels, has been changed so that independent reversible engines are now employed; and instead of the vertical, submerged-flue type of boiler in the old machines, the newer products of the shovel builders are equipped with locomotive boilers.



A Sixty-Five Ton Shovel Engaged in Railroad Work.



Loading Ore from a Stock-Pile with a Sixty-Five Ton Shovel.

IMPROVEMENTS IN STEAM SHOVELS.

Some recent achievements constitute a revelation of the possibilities of the new types of shovels. On the Great Northern Railroad, recently, a 65-ton shovel took out 4,300 cubic yards of sand in a single day, and, during an interval of several months, took out an average of 2,291 yards per day. At Ishpeming, Mich., last season, a 65-ton shovel handled 120,000 tons of iron ore with practically no breakage or delay for repairs. A still more striking example of the endurance of the modern steam shovel is afforded by two 60-ton machines at the Lake Superior Consolidated Iron Mines, which handled without a break 304,326 tons of iron ore, 135,048 cubic yards of gravel, and 76,177 cubic yards of dirt from railroad cuts.

A standard medium-size shovel, in use on railroad work in the West, lately made a record of 1,330 cubic yards per day for twenty-seven months, a large portion of the material handled being rock. As affording an interesting criterion of the cost of operation of a steam shovel under modern conditions, it might be cited that there is at a mine stock pile at Ironwood, Mich., a shovel which has been in practically continuous operation for five years past and has, during that period, loaded a total of 430,036 tons of iron ore at a cost of 2.53 cents per ton, which includes a charge of 0.31 cent per ton for repairs.

Railroad construction work has, from the outset, constituted one of the most important avenues of usefulness for the steam shovel; but the past year or two have afforded revelations of the capabilities of the machines in this line of work. Special opportunities were offered for steam shovels in the case of the improvements recently undertaken on the Union Pacific Railway, in eastern Wyoming, from the fact that the work was remarkable for the large amount of material required in the construction of embankments and in building the Sherman Hill and other tunnels. The famous Dale Creek fill, near Tie Siding, Wyo., is 120 feet in height and 900 feet in length, and the 500,000 cubic yards of material used in its construction were excavated by two steam shovels. This fill, with two adjacent embankments, required 750,000 cubic yards of filling within the distance of one mile. In the construction of the famous Sherman Hill Tunnel, there were employed three steam shovels, which were especially built for the purpose. The tunnel is 17 feet in width, and this made it necessary to equip the shovels with short booms. Compressed air was employed for the operation of the machines. Prior to the commencement of work upon the Sherman Hill Tunnel, 300 feet per month constituted the best record for steam shoveling under similar conditions; but in the case of this Wyoming contract, as high as 500 feet were excavated in a month.

Not less interesting than the improvements that have been made in the shovels themselves, are the new fields of activity which have been opened to these powerful mechanical workers. One of these is found in gold placer mining, in which there has lately been a considerable revival of interest. The steam shovel is adapted for dry-land mining, or where but little water is found; and where the gold-bearing material is covered with an overburden of barren gravel or earth, the steam shovel is especially suited, as the stripping can be disposed of readily.

A valuable adaptation of the steam shovel is found in the sewer excavating machine, which has lately been introduced. This machine consists practically of one of the moderate-sized steam shovels—say the 45-ton type—mounted upon heavy cross-beams and rollers and fitted with a long handle and special dipper. Such a machine is capable of digging a trench up to 12 feet in width and 20 feet deep. It carries a dipper of special construction, in which the cutting edge is the widest part, so that the lugs and fastening for the bail are clear.

In view of the probable extensive employment of steam shovels in the completion of the Panama Canal under the jurisdiction of the United States government, it is interesting to note the previous accomplishments of these shovels in canal excavation. In the recent deepening and enlargement of the Soulanges Canal, the most important link in the system of artificial waterways along the St. Lawrence River, steam shovels were extensively employed; and a single machine excavated 600,000 cubic yards of blue clay and 30,000 cubic yards of hard pan and bowlders of the very worst and hardest material. This latter, it may be remarked, was excavated without the use of dynamite. Two steam shovels met unusual exactions in the construction of the Massena Canal, at Massena, N. Y.; and the record of these great mechanical shovelers in the construction of the Chicago Drainage Canal is well known. Sixty-five-ton shovels were employed principally in excavating for the Chicago waterway, and, considering the enormous quantities of rock and other difficult materials handled, the break-downs were surprisingly few in number.

Chains constitute one of the most important component parts of a steam shovel; and, in order to secure increased efficiency in this class of material, steam-shovel manufacturers are now establishing their own chain factories, where hand-made chains, varying in size from ½ to 2 inches, are turned out. Last year a single shovel manufactory produced, for use on its own machines, 22,500 tons of chain, all made from a special grade of iron. Every bar of this iron is subjected to a most severe test, for the demands upon the chains in use on steam shovels are so severe that the metal employed in ordinary chains will not withstand the strain. The test to which the chain material is subjected consists of placing the end of a bar under a trip hammer, bending it over cold, and hammering it down solid with the bar. If a check or a flaw is shown, the bar is discarded.

On the 95-ton shovel here shown, 1½-inch hoisting chain is employed. A pull on the dipper of 116,000 pounds is obtained with a working steam pressure of 100 pounds to the square inch.

There are three independent reversible engines—one for hoisting the dipper, one for swinging the boom, and one for thrusting the dipper into the cut. The first two are located on the car and the third is located near the lower end of the boom.

The main engines gear directly to a large gear on the shaft of the hoisting drum. The sprocket chains shown beneath the car, which are used for moving it ahead, are both driven by the shaft located under the middle of the car. This shaft is driven by gearing from the hoisting shaft.

The swinging engines are geared through an intermediate speed reduction shaft to the large swinging gear which is bolted to the swinging drum. From the swinging drum the wire ropes lead around the swinging circle in opposite directions. The engines and large gear-wheel of the swinging drum can be seen through the open panel of the side of the car.

The boom engines gear directly to the two large gears mounted on a short transverse shaft on the boom. Near the middle point of this shaft are located two pinions which gear with the two racks on the dipper arm. When the engine is in motion, the dipper arm is forced out or in, depending upon the direction of rotation of the engines. The boom is not raised or lowered while in operation, but can be swung through an angle of about 180 degrees about a vertical axis.

A great deal of the railroad work being done throughout the country in the way of improving existing lines consists of double-tracking former single-track lines.

The cheapest way of doing this work is to use a steam shovel working parallel to the existing track and at such a distance from the track that it can load the material excavated upon cars placed on the track. In one cut, the shovel can prepare the ground for the laying of ties and rails for the new track. The only difficulty in this manner of working is that delays are likely to occur to traffic, owing to the presence of the gravel train on the main line.

The solution of the problem was the design of the 95-ton shovel, capable of handling a dipper with a capacity of 5 cubic yards, and working as fast as any shovel of smaller size can work. This shovel can dig at the rate of four shovelfuls per minute in the material usually encountered. The customary size of dipper now in use has a capacity of 2½ cubic yards—one-half that of the 95-ton shovel. By using the large shovel the gravel train is loaded and able to move out of the way of fast trains in just half the time required with the usual size of steam shovel. These large shovels are also suitable for excavating iron ore from open mines, in which case they are equipped with a dipper sometimes as small as a yard and a half.

Wood Silk.

News comes from abroad that an Englishman has patented a method of making imitation silk from wood. A plant erected near Sydowsaue, Germany, is at present turning out 50 pounds of skein silk a day, which product can be increased in quantity to 2,000 pounds. The silk is soft in texture, and cream in color. Each thread is made up of eighteen single strands; a single strand is hardly perceptible to the naked eye. In strength, the real silk is two-thirds stronger than the imitation. When woven into pieces, the new substitute is said to have the appearance of real silk. How this new article will compare with the genuine, in the matter of wear and price, it is impossible at present to state. The manufacturing process is likewise undiscoverable. It is asserted, however, that the pulp undergoes a chemical process and is pressed through very fine tubes, by hydraulic pressure, forming the single strands which go to make up the thread.

THE PROJECTIONS OF THE PLANET MARS.

Every two years, when the planet Mars comes into favorable position for observation from the earth, astronomers are able to see, now and then, one or more irregular projections on the sunrise or sunset line. One of these was observed recently at the Flagstaff Observatory, and reported in the newspapers.

The nature of these projections is pretty well understood by astronomers, but the biennial press reports of such observations give rise to a question on the part of the public as to whether they could be signals from intelligent beings on that planet.

These bright projections were unknown up to 1890, when the first ones were observed with the great Lick telescope, this instrument having been mounted too late in the year 1888 to permit observations of this kind being made at that time. The 1890 observations are well illustrated in the accompanying drawing, *B*, which has thus far been published only in technical journals. Fig. 1 represents the planet Mars as circular in form, at about the time when the sun, the earth, and the planet were approximately in the same straight line. When Fig. 2 was made, the relative positions of these objects had changed, and Mars no longer appeared as a complete circle; it had the gibbous form of our moon when ten or eleven days old. Only that hemisphere of Mars upon which the sun is shining is bright; and as a portion of the dark hemisphere was turned toward the earth on July 6, a considerable crescent on the side marked *T* was invisible. The edge of the planet bordering the invisible crescent is known as the "terminator," and in this case it was the line of sunrise. It is always upon the terminator that the projections referred to are seen. A glance at the drawing will show the appearance and positions of the two that were first observed by astronomers.

Those who have critically observed the terminator of the moon when ten or eleven days old will have no difficulty in detecting, even by naked eye, similar bright projections on that body. There is no question as to their nature. Mountain peaks of considerable elevation catch the first rays of the rising sun or the last rays of the setting sun, the lower levels at that time being below the line of the rays, and therefore absolutely invisible. Looking at the moon's sunrise line from our point of vantage, these illuminated elevations will therefore appear as bright projections extending from the terminator a short distance into the dark sky.

The bright projections on the terminator of Mars have a similar origin, though, instead of being elevated land areas, it is reasonably certain that they are clouds in the thin atmosphere of the planet. If they were mountains they would be seen again and again, not only from night to night, but at each returning opposition, and in exactly the same places. This is not at all the case. They are occasionally observed in substantially the same position on two, three, or four successive nights; but never, I believe, for a longer period than this, and their forms change from day to day. They are not fixed features of the planet's surface. In this connection, however, it should be said that a mountain twelve or fifteen thousand feet high should probably form a fairly conspicuous projection on the terminator when the planet is in the most favorable position.

All the observed phenomena can be satisfactorily accounted for on the theory that the projections are due to clouds of considerable size, at great elevations in the rarefied atmosphere. Such clouds would be illuminated by the sun's rays while the land areas beneath them were still so dark as to form in effect a black background, and the contrast between them and the planet's surface would be very great.

The comparatively small number of these projections is strong evidence that the atmosphere of Mars is remarkably clear as compared with that of the earth. This is in complete harmony with our knowledge derived from spectroscopic observations, that the atmosphere of the planet is very rarefied—its density at Mars' surface probably being much lower than that of our atmosphere at the summit of Mount Everest. The scarcity of clouds is still further demonstrated by the practically uninterrupted view which astronomers are able to obtain of the planet's principal surface features. W. W. Campbell, Director.

Lick Observatory.

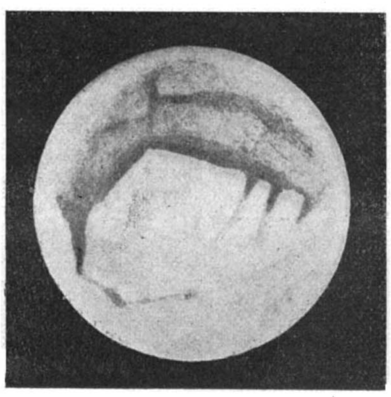


Fig. 1.—Mars on May 29, 1890.

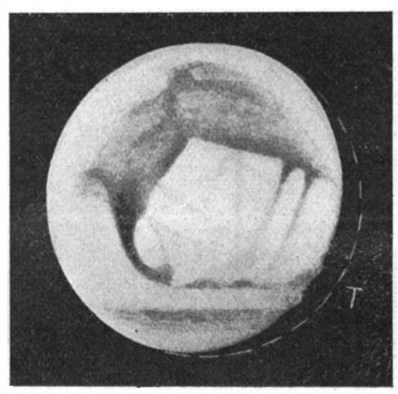


Fig. 2.—Mars on July 6, 1890, Showing Protuberances.

PHOTOGRAPHS OF MARS TAKEN WITH LICK 36-INCH TELESCOPE.

It will be remembered that in our last issue we mentioned the fact that the Governor of the State of Texas had offered a prize of $50,000 for the best method of eradicating the cotton-boll pest. The first claimant of the prize is George Franklin, a farmer living near San Marcos, Texas. He has submitted his claim to Gov. Lanham. His remedy will be passed upon by a committee of five farmers whom the Governor will appoint for the purpose.

Portland Cement from Slag.

Portland cement has been made from blast-furnace slag for several years in various cement works in Germany, Luxemburg, and Belgium, and has yielded very satisfactory results, especially in regard to quality. Negotiations are being carried on with some blast-furnace works with a view to the introduction of the slag-cement industry into England, Austria, and France. In some respects a blast works has a considerable advantage over other Portland-cement factories because the motive power for the cement works can be supplied by a blast-furnace gas motor with electric transmission, the rubble or waste coke from the blast furnaces can be utilized in the cement kiln, and the principal raw materials—namely, the granulated slag and the limestone—are close at hand. Besides, there are other minor advantages.

Portland slag cement has also some advantages over natural Portland cement; for, while the yield from the raw materials when the former is used is about 80 per cent, the yield when the ordinary raw materials are used is seldom more than 60 per cent. As the cost of production per ton of raw materials is nearly equal in both cases, a saving of about 20 per cent in fuel, labor, etc., is effected in the case of slag cement. Besides this, Portland slag cement is more trustworthy and more regular, and its manufacture can be more easily controlled than that of the so-called natural Portland cement, because the principal raw material—namely, the blast-furnace slag—is, as a rule, a regular product whose chemical composition is easily controlled; consequently, any alterations which are liable to take place are known beforehand and precautions can accordingly be taken in time. This is not the case when the natural raw materials are used.

Some recent tests with Portland cement from blast-furnace slag, made in the municipal laboratory at Vienna, showed that mortar composed of 3 parts of sand with 1 part of this cement gave the following results:

1. After seven days' hardening. Tensile strength, 383 pounds per square inch; strength of compression, 3,880 pounds per square inch.

2. After twenty-eight days' hardening. Tensile strength, 551 pounds per square inch; strength of compression, 5,411 pounds per square inch.

New German Inventions.

Prevention of the Warping of Xylolithe Floors.—An Austrian inventor claims to have discovered a method of preventing the warping of floors constructed of xylolithe (a mixture of sawdust, burnt magnesite, and magnesium chloride). He does this by fixing sheet-iron, open-work, or reticulated plates to the foundation and imbedding them in the plastic material. For covering iron floors in ships, etc., the reticulated plates are laid loosely on the foundation and a series of crosscuts are made in the partially hardened xylolithe covering by thin knife blades to allow for expansion.

Plastic Flooring.—A German invention deals with the manufacture of plastic compositions for flooring purposes. Ash, moistened with a solution of sulphate and chloride of magnesium, is mixed with kaolin, or clay, and talc; gypsum and magnesite are then added. The mixture is stamped and rolled in place while cool to form the bed or foundation of a jointless floor. When the bed has hardened, a surface layer composed of asbestos and sawdust moistened with magnesium, sulphate, and chloride and mixed with kaolin, or clay, and talc, gypsum, and magnesite is applied.

Cylindrical Blank Piercing.—As outlined in a recent German invention, a tube or other hollow body is formed from a cylindrical blank by piercing it with a pointed mandrel while the blank is held in a divided matrix, or die. The blank is first held endwise by a block and wedge arrangement until the mandrel has penetrated sufficiently to force some of the hot metal into cavities in the matrix. The swellings thus produced serve to hold the blank in place, after the block and wedge have been removed, till it has been completely pierced. The tube produced is considerably longer than the blank, and therefore a relatively longer mandrel has to be used. The swellings are removed by subsequent rolling or drawing.

Seamless Pipes and Tubes.—In another German invention, relating to the manufacture of seamless pipes and tubes, a set of nested tubular blanks is rolled or drawn on a mandrel so that tubes of various diameters are simultaneously produced. Each blank just fits into the surrounding one, the inner blank fitting the mandrel, and each blank is given a protective coating, which may consist of milk of lime or a mixture of graphite and coal to prevent a grinding or welding together of the blanks during reduction.

Fuel Grating.—A casing which is interposed between the wall and the fire bars of an inclined grate to increase the draft forms the subject of a recently issued German patent. The casing comprises a frame —preferably made in two sections—secured to the walls by lugs in such a manner that the part nearest to the inclined fire bars is easily replaced. The frame holds the downward extended plates together by means of bridge pieces, and the upper surfaces of the frame and the plates slope down from the walls to the fire bars to keep the fuel in the middle as it slides down the grate.

Punching and Shearing Machine.—A somewhat novel design of a punching and shearing machine has been put on the market by a German firm. The feature which distinguishes it from other designs is that it is cut away longitudinally on one side to allow of a broad plate being cut up the middle. It will be worth a great deal in shipyards and bridge works, for in such works plates are usually ordered in the dimensions required, and they only require a little cutting and trimming around the edges. It can hardly fail to vibrate considerably while at work. In all other respects the machine resembles other well-known makes of eccentric machines. It is made to shear plates up to 1 inch in thickness, and the shears are in a line with the longitudinal axis of the machine. The gap on the punching side is only 19½ inches, and it is intended to punch 1⅛-inch holes through 1-inch plate. The angle-iron shear in the middle has the corner down, and is thus quite unsuitable for shipbuilders.

Coburg. Oliver J. D. Hughes, U. S. Consul.

The Heligoland Lighthouse.

The German government has erected a new lighthouse on the island of Heligoland, which will supplant the old petroleum lamp that has long directed the commerce at the mouth of the Elbe. It is claimed for this light that it is one of the most powerful in operation. The distinguishing feature is the return that has been made to the old form of parabolic reflector, with a powerful illuminant in the focus, in place of the Fresnel lenses and prisms. The mirror in this case is of glass, 75 centimeters in diameter, and silvered at the back. An arc light with a current of 34 amperes is the illuminant. The positive pole of the carbon is so near the focus that it is estimated that the beam is not more than two degrees in diameter, and its candle-power is quoted as thirty millions. No protection against weather is provided in front of the light, and it is asserted that none is needed. Three similar mirrors and lamps are mounted in one plane round an axis, and the whole revolves four times in a minute, so that a flash is given every five seconds. A fourth mirror and lamp is provided in case of necessity, which will turn three times as rapidly, but it is not proposed to use this except in case of emergency. The duration of the flash is only one-tenth of a second. Herein the German firm of Schuckert & Co., the manufacturers, have followed the lead of the French authorities. It is, however, a question whether these brief durations have not been carried to an extreme. Undoubtedly one-tenth of a second is sufficient to make the maximum impression on the eye, when the light is brilliant. But with a hazy atmosphere, and the light much diminished, it is doubtful whether a longer duration should not be allowed. The experiment will be watched with great interest, both on account of the bold deviation from the ordinary plan which has been so long followed, and also on the ground of economy, which is claimed for the new method. It is stated that on the first night of trial the light was seen at the pier of Büsum, a distance of 64 kilometers, or 40 miles.—Nature.

Tesla's Doings.

According to the newspapers, strange things are happening at Wardencliffe, L. I., where Tesla has his laboratory.

Ever since Mr. Tesla retired from the public gaze and hid himself in Long Island, he has been credited with performing strange feats. These rumors are at last confirmed. For some time, residents about the laboratory have been startled by vivid flashes of light emanating from a tall tower erected by the inventor. Just what this tall tower, and the gleams and flashes which come and go, may mean, no one knows; but it is to be inferred that Mr. Tesla is bent upon improving the present methods of telegraphing by the Hertzian waves.

The Current Supplement.

The current Supplement, No. 1439, opens with an excellent description of the widening of London Bridge, by Mr. Harold J. Shepstone. The article is admirably illustrated. Dr. Oskar Markfeldt discusses coal-tar oils in the manufacture of paint and varnish. A paper on another chemical subject is: "The Preparation of Firm Lubricants." Mr. E. Hirsch tells something of "Catatypy," a new printing process without light. At one of the recent German engineers' conventions, Geheimrath Wichert presented a paper on train lighting with steam turbines. Abstracts of this paper are printed in the current Supplement, which are well illustrated by photographs and diagrams. The manufacture of steel by the electric furnace is discussed in an essay which is full of practical suggestions. A novel use for the automobile is described in an article bearing the title: "An Automobile Railway Trolley Tower Wagon." The articles on the Serpollet steam carriage are continued. Mr. J. R. Collins describes the application of Kelvin's theory of the ether to the stellar universe. Mr. Emile Guarini tells of a new method for the study of storms, in an article in which he describes the Lera apparatus for registering atmospheric electrical discharges. The usual Trade Notes, consular information, Selected Formulæ, and Electrical and Engineering notes will be found in their accustomed places.

The Effect of Borax Food Preservatives on the Human System—Dr. Wiley's Work.

Readers of the Scientific American have probably followed with interest Dr. Wiley's experiments on the "Borax Squad," as the band of young men who willingly ate various kinds of canned foods and meats given to them by Dr. Wiley, are called. It is impossible at this early date to state definitely what the experiment will finally demonstrate. Two facts at least have been proven. The first of these is that the use of borax preservatives in food diminishes the natural weight of the human body, and that persons who consume such food will not return at once to their former weight when the experiments are stopped. The second fact is that the use of borax tends to reduce the amount of nitrogen in the human body, and that the volume of nitrogen will not again return to that existing before the experiments.

In an address before the National Association of Food Commissioners, Dr. Wiley, in summing up the results of his work, said: "Foods can be preserved for a reasonable length of time in most circumstances without resorting to any chemical preservative or added preservative of any kind. Simple sterilization, which can be applied to most foods, is most effective and the least objectionable of all forms of food preservation. There may be occasions of emergency or exigency in which the use of a chemical preservative is rendered imperative.

"It may be a wise policy not to inaugurate absolute prohibition against all preservatives, but it certainly is true that wherever for any reason a preservative must be used, the package of food containing it should be clearly marked."

Death of E. W. Bliss.

Eliphalet W. Bliss, of the E. W. Bliss Company, one of the ninety-two "Captains of Industry" who took luncheon with Prince Henry on his recent visit, died suddenly at his home at Owl's Head, Bay Ridge, on June 21. Mr. Bliss was an inventor and manufacturer of presses and dies, as well as a maker of special machinery for working sheet metals. He was the sole manufacturer of the Whitehead torpedo, and naval appliances used in the United States navy.

Bacteria for Farmers.

For many years the Agricultural Department has made it a rule to distribute gratuitously rare seeds for the use of farmers; it has now announced that it is willing to place at the disposal of agriculturists, bacteria which would enrich the soil. It is the purpose of the department to send out bacteria which will assist in the protection of leguminous plants, such as clover, peas, beans, and locust trees. The bacteria which will enrich the soil. It is the pur- of the air into a nitrate which can be easily digested by the plant. Of particular service will these bacteria be in the growing of alfalfa.

News of Langley's Airship.

During a heavy storm off Widewater, Va., on the morning of July 19, Prof. Langley's houseboat, and with it his flying machine, was torn from its moorings and carried by a swift flood tide up the Potomac River. Although the airship itself suffered no material injury, there was a time when Prof. Langley's aerodrome was in danger of being utterly destroyed.

Experiments are shortly to be made. Such is the secrecy which is being maintained, that it will be doubtful if information of any value can be obtained for some time to come.

A special commission appointed by the French Admiralty has been experimenting with a view to obtaining conclusive data as to what would be the effect on a battleship when the guns in the fore turret were fired. The battleship "Henri IV." was selected for the purposes of these tests. Sheep were distributed at the posts which in action would be occupied by the members of the crew serving the smaller guns over which the big turret guns fire. After the discharge the sheep were examined, and though found to be stunned were otherwise uninjured. It was therefore concluded that as men have a greater power of resistance than sheep, the gunners in the turret would experience no serious harm through the firing of the guns.

THE VOLCANIC ERUPTIONS IN GUATEMALA.

BY J. WINTERTON.

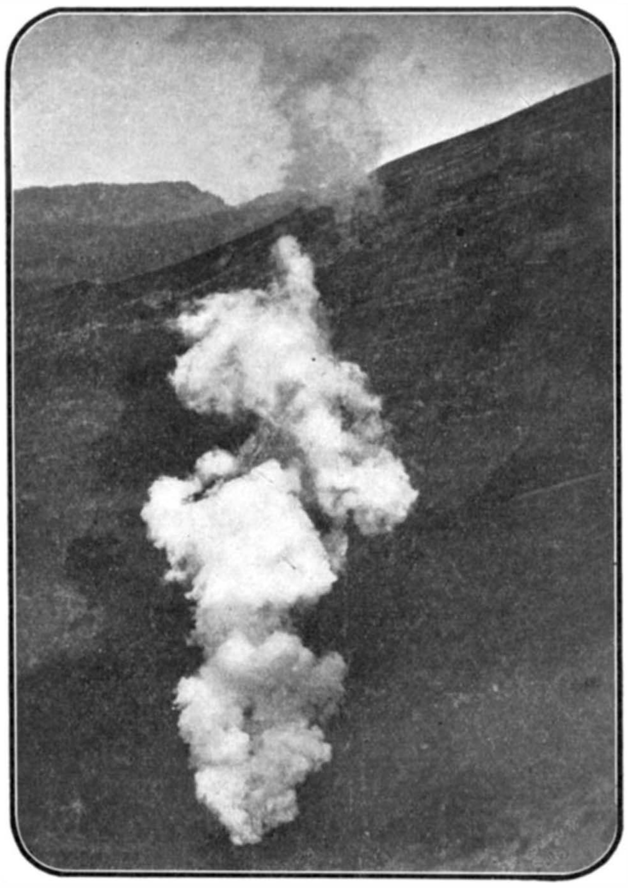
For three weeks last autumn a great column of smoke rose from behind the peak of Santa Maria near Quezaltenango. Then the eruption abated in violence, and the dense pillar of smoke gave place to smaller columns of white steam. Emboldened by the subsidence of the volcano, Mr. Heinrich Siegerest and a few others determined to explore Santa Maria. After no little difficulty they succeeded in reaching the crater.

Encouraged by their success, although somewhat disconcerted by their account of the hardships they had endured, I started from the railroad terminus at the town of Santa Felipe on December 15, accompanied by three Indian carriers, to ascend the volcano for the purpose of obtaining photographs. Our road passed through Palmar, once a flourishing coast town, now a devastated community with ruined dwellings, dismantled government buildings, and fields blighted by volcanic sand and ashes.

I began the ascent of the volcano from the plantation of La Sabina, a favorite health resort famous for its springs of mineral water. Journeying from Palmar to La Sabina, we passed two plantations whose buildings were ruined and fields devastated. Arriving at La Sabina, we found the hotel of the town buried many feet beneath mud. I found Mr. W. D. Middaugh, proprietor of the hotel, sinking a shaft for the purpose of recovering some of the hotel valuables. Mr. Middaugh advised me to climb the ridge to the left of La Sabina, in order to reach the peak of Santa Maria. I followed his advice, and discovered that the road was much easier than that pursued by Siegerest and his companions.

I found the crater a huge pit some 500 feet in depth, from the bottom of which spouted a magnificent geyser. The steam issued with terrible force, roaring and crackling. In order to secure the picture of the geyser herewith presented, it was necessary to place the tripod of the camera on the very edge of the crater, on a small ridge which had been partially destroyed by landslides. Almost at my very feet arose another geyser, through the vapor of which there could be dimly seen a large pool formed by the condensed steam. Besides the large geysers, innumerable small jets of steam spouted from the edge of the crater in a vaporous fringe, sending forth little clouds toward the center. At intervals a strong odor of sulphur assailed the nostrils. Fortunately, the wind was blowing from me most of the time.

It is probable that when the volcano was in full eruption the entire crater was open; for the earth seemed to have fallen in and to have formed a kind of floor. Otherwise it would be impossible to account for the enormous mass of material ejected by the crater. Around La Sabina the sand and ashes have been converted into mud by terrific floods that followed the eruption. One of the views which I took clearly shows how deep is this mud formation. From the manner in which the more distant plantations are recovering their verdure, it is evident that the volcanic deposit contains nothing injurious to vegetation.



The Crater of Santa Maria.

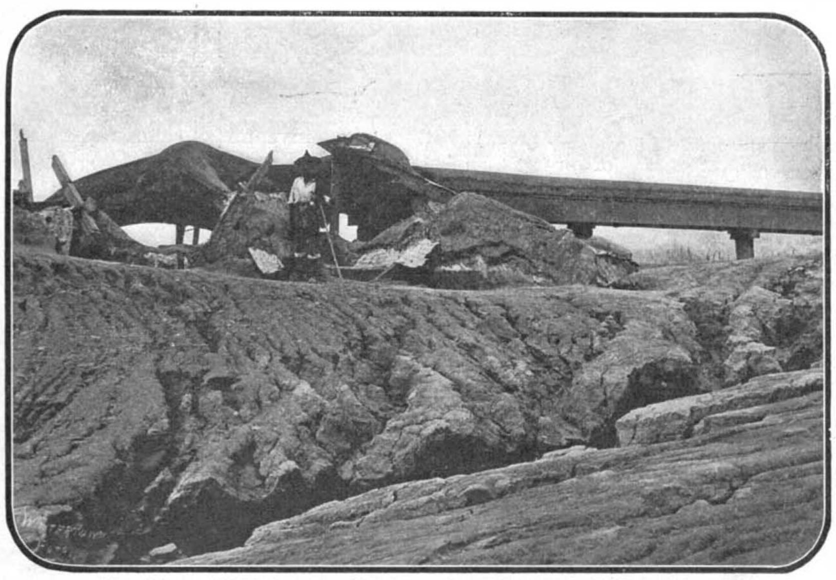
THE ORE-CARRYING WIRE ROPEWAY AT VIVERO, SPAIN.

On the north coast of Spain, not far from the port of Ferrol, lies the little harbor of Vivero, from which there extend inland important iron mines. Especially rich and extensive are two mines worked by the Vivero Iron Ore Company, Ltd., London, and situated about three or four miles from the coast, near the Monte Silvarosa and gorge of Lavandeira which passes on inland from this mountain.

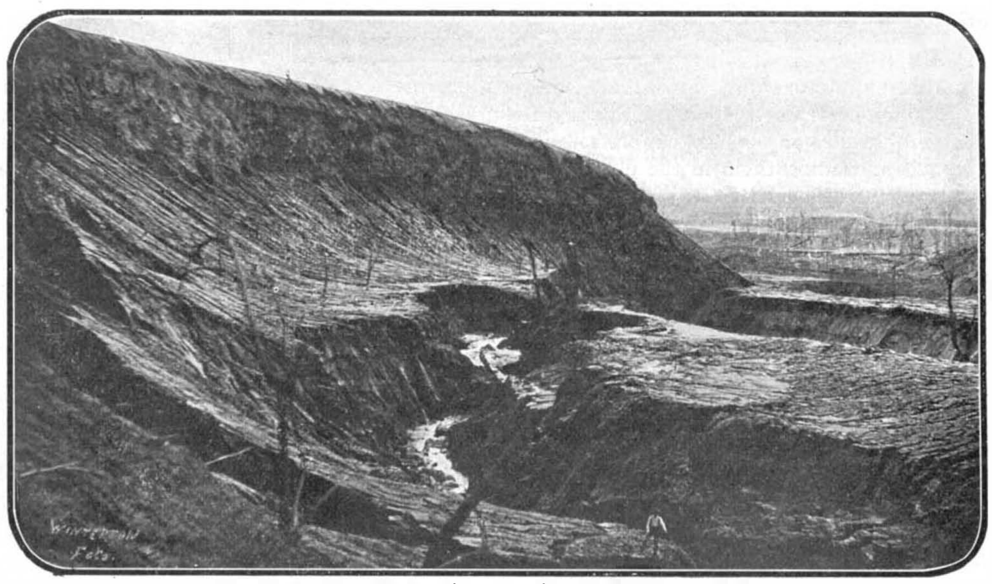
No highway leads from these mines to the coast, for which reason the matter of providing a suitable mode of transport is of supreme importance. The construction of a narrow-gage railway in this mountainous district would involve very considerable expense, merely in acquiring the land and in making a permanent way, which would necessarily be tortuous. The advantages of a wire ropeway, on the other hand, are just in a case of this kind most pronounced. The service is safe and cheap; gradients of one in one are surmounted without inconvenience, and valleys three or four thousand feet across are readily spanned. The work of constructing the ropeway was entrusted to the firm of Adolf Bleichert & Co., of Leipzig Gohlis, Germany, who, for the last thirty years, have made a specialty of this branch of engineering.

The purpose of our present article is to give a description of this installation, and, in order to make it more intelligible, it will be advisable briefly to explain the general construction of a Bleichert wire ropeway.

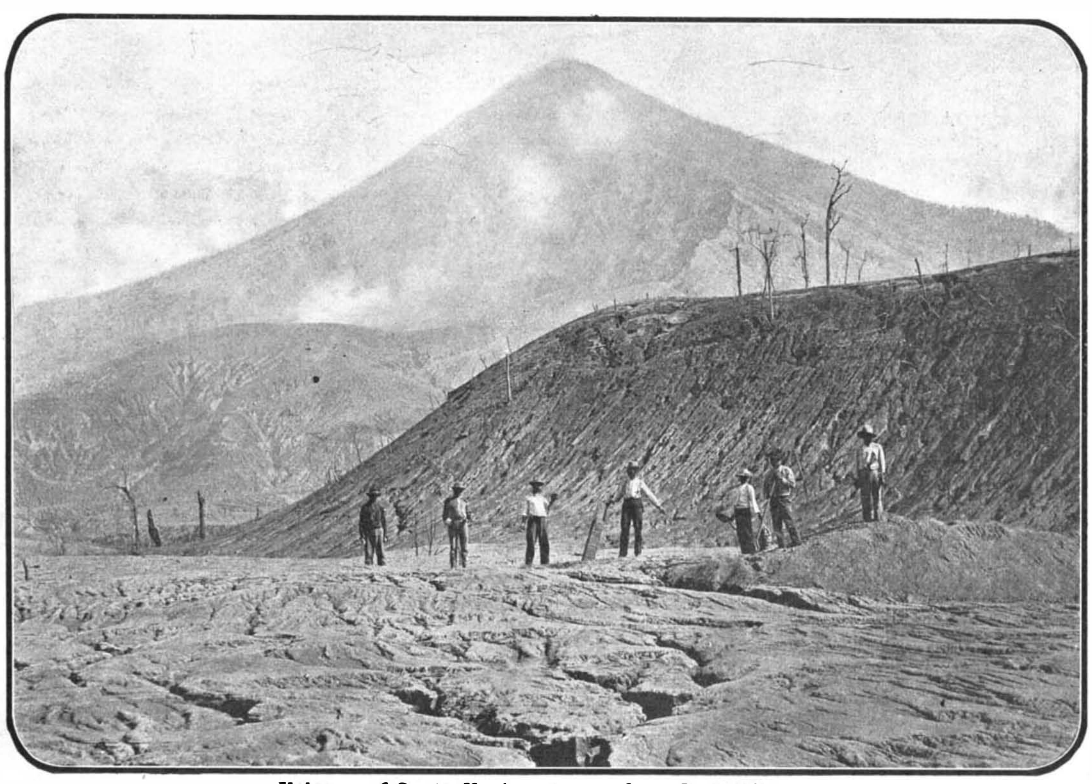
Wire ropeways are mostly used for continuous service, with one line for loaded cars and another for empties. Each consists of a wire rope or cable which is firmly anchored in the ground at one end, while the other end passes over a pulley and is heavily weighted, so as to keep the line tightly stretched. At the stations, a network of suspension rails provides for the charging, discharging, and shunting of the cars, according to the requirements of the plant, and also serves to effect the transference of the cars from the one line to the other. Each car consists of a two-wheeled carriage which is provided with an automatic grip and which carries the bucket. Traction is effected by



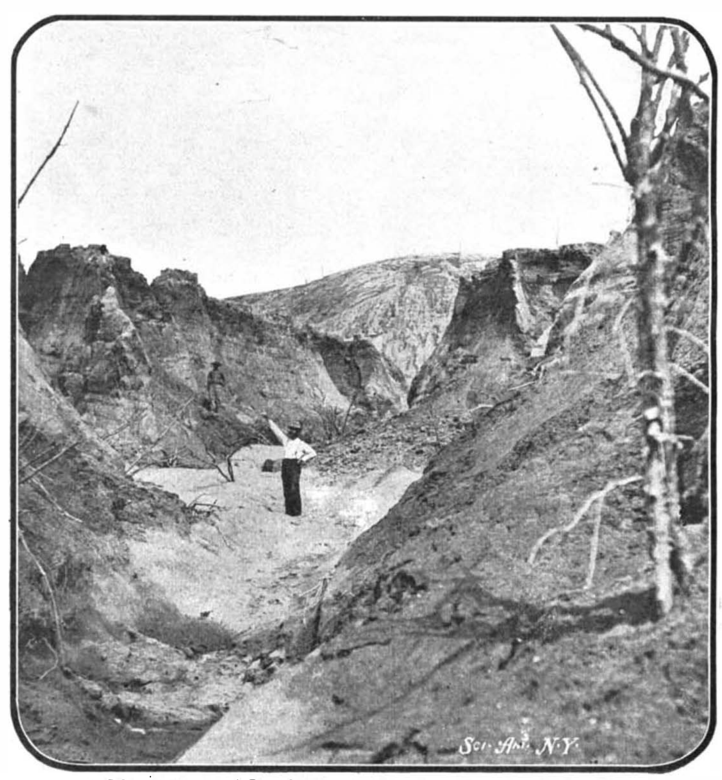
The Water-Wheel at La Sabina, covered with Volcanic Mud.



View from La Sabina, showing the General Devastation.



Volcano of Santa Maria, as seen from La Sabina.



A Plantation of La Sabina, showing Depth of the Mud.

SCENES FROM THE REGION OF THE GUATEMALA VOLCANIC ERUPTIONS.

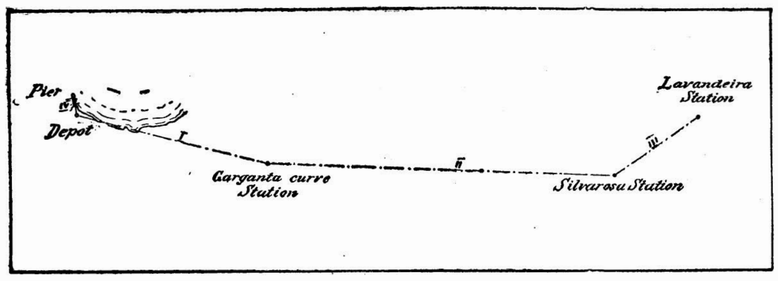


Fig. 1.—Plan of the Four Lines.

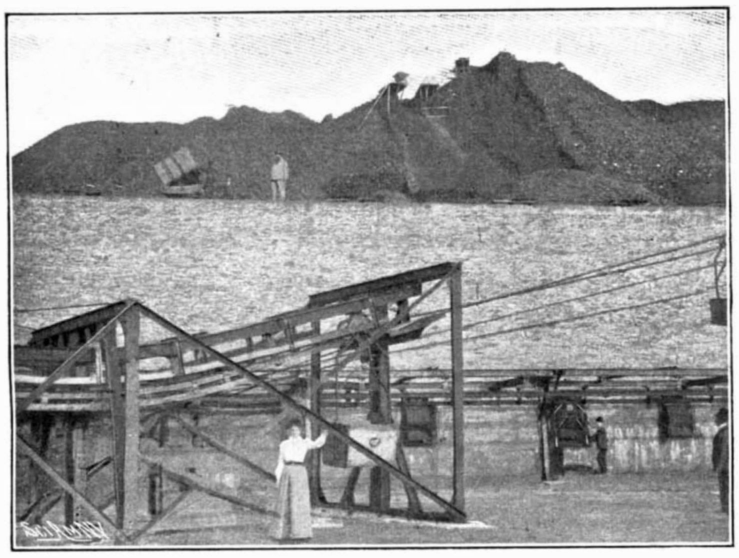


Fig. 2.—The Central Station at Silvarosa

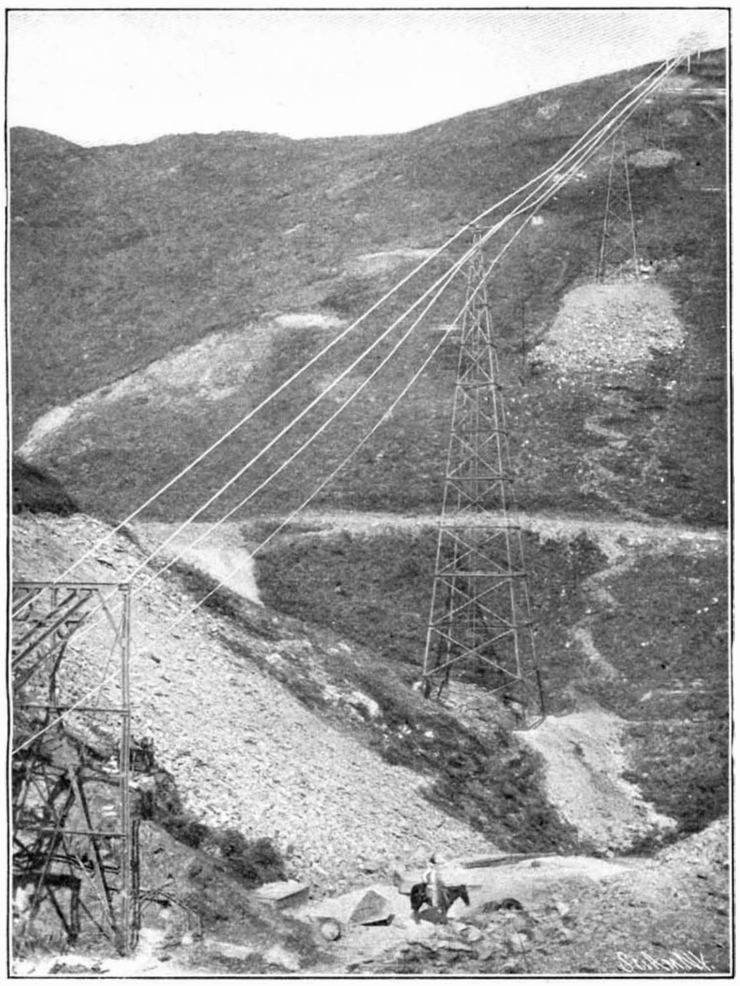


Fig. 3.—Crossing the Lavandeira Gorge.

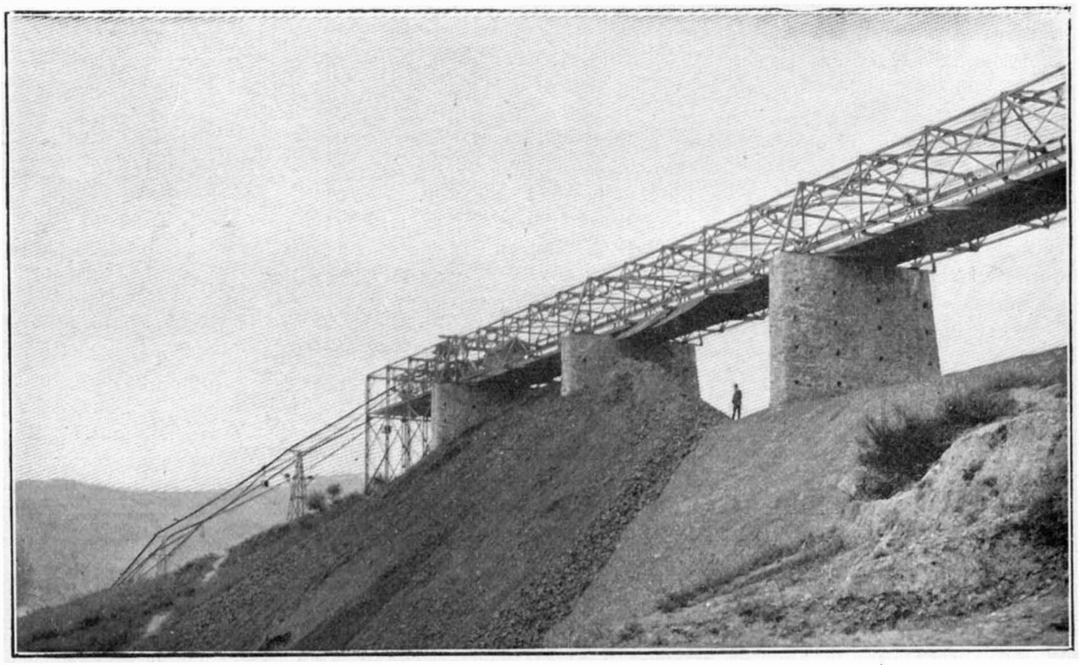


Fig. 4.—The Dumping Ground at the Coast Station.

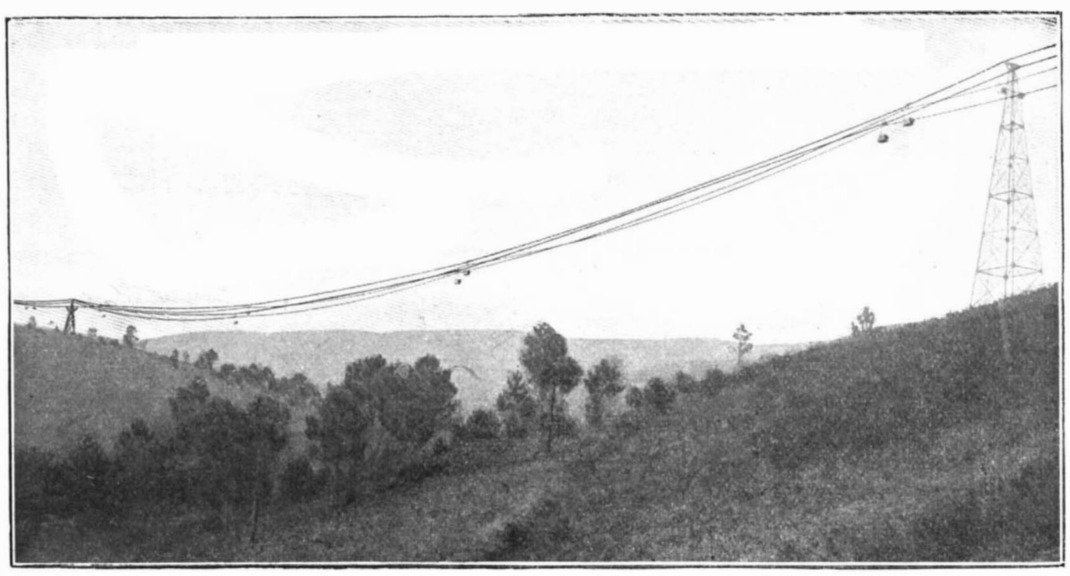


Fig. 5.—The Longest Span on the Line. (324 Meters = 1,064 Feet.)

Fig. 6.—Coast Station and Lading Pier.

THE ORE-CARRYING WIRE-ROPEWAY AT VIVERO, SPAIN

means of a long wire rope running over large sheaves at each end of the line. One of these is connected with the driving power, where necessary. (Under suitable conditions of incline the line works automatically without any external assistance.) The other sheave is in connection with the tension gear.

Our diagram indicates the conditions of service from the mines to the shore. There are in all four lines, as follows:

1. From the charging station Silvarosa to the depot on the shore: lines I. and II.

2. From the charging station Lavandeira to the station Silvarosa, and from there without reloading to the depot of the main line on the shore: line III.

3. From the depot on the shore to the pier head: line IV. The service on this line is independent of the other three lines.

Only the lines I., II., and IV. were at first erected, the line III. being built later. It is this third line that we will describe first.

This line starts from the Lavandeira gorge. Here the rock had to be blasted to provide accommodation for the charging station. A wall 10 meters (33 feet) high was built diagonally across the cutting. The ore is carried in dumping trucks to the top of this wall and thence dumped into a depot below. Here the ore is shipped from four stock-bins into the ropeway cars. A workman pushes each car as it is loaded to a point where the grip is applied automatically, and the car travels to Silvarosa station. In our third illustration the ropeway of this line is shown. In the left-hand bottom corner a portion of the station appears; and 56 meters (185 feet) from it the first iron pillar, 34 meters (112 feet) high. From this pillar to the next is a span of 72 meters (236 feet) across the Lavandeira gorge. On the right of this ropeway rises the Monte Silvarosa, the line running along its flank. The depot at the Silvarosa station is arranged like that at the Lavandeira gorge and has accommodations for 10,000 tons of ore.

The central station (Silvarosa) belongs partly to the newer Lavandeira line and partly to the old main line running to the sea. These lines are so connected as to allow the main line to be worked with or without the branch line. If both lines are worked, the cars of the branch line proceed to the main line without causing any inconvenience in the loading of the cars at the Silvarosa station. The arrangement is shown in part in our second figure, where the portion on the left, carrying the suspension rails, is the more recent connection with the older part on the right, of which the suspension and traction ropes and a car are visible.

The main line consists of two branches joined at the Garganta Curve station. The steepest incline occurs on the main line between the Silvarosa station and the Garganta curve, the gradient being about one in four. There are also on this part of the line spans ranging up to 324 meters and crossing deep valleys. One of these is shown in Fig. 5. It is 324 meters (1,064 feet) wide and passes at a height of 70 meters (230 feet) above the level of the valley. Half way between the Silvarosa and the curve station is an intermediate tension gear, which equalizes the strain of the rope along its 2,900 meters (9,600 feet) length.

The erection of the Garganta Curve station was rendered necessary by peculiarities in the nature of the locality. The two lines here meet at an angle of 170 deg. Each has a separate traction rope. The supporting ropes are firmly anchored in the ground, and in the station the cars run upon suspension rails (not ropes). The cars must be unclamped and again clamped to the traction rope by hand, but the operation is so simple that two men are sufficient for the work, although the traffic is very considerable. The traction rope of the upper line is provided at the curve station with an automatic tension gear, which is connected with the lower line in such a way as to equalize the speed on the two lines and transfer the surplus of power from the one to the other. The second part of the main line, extending from the curve station to the shore, offered no particular difficulties beyond the crossing of an arm of the sea some 280 meters (924 feet) wide. This part of the line, with its terminus on the shore, is shown in Fig. 6, while Fig. 4 is a view of the dumping ground on which the ore is stored at that terminus. The cars arrive on a bridge supported on masonry pillars, and from here their contents are dropped out upon the inclined embankment on which the pillars of the bridge stand. The bridge is about 52 feet high and 180 feet long; the quantity of ore which can be stored here is about 30,000 tons. From this ground the ore is transferred to the ship by a special lading line. It was found best to have a break in the line here, as the main line works continuously, bringing a regular supply of ore, its working capacity being about 67 tons per hour, while the lading line works only when required. This arrangement makes it possible to effect the lading of a ship very rapidly, so that every favorable opportunity of sailing and weather can be used to the best advantage. It is possible to put no less than 3,000 tons of ore on board in one day, the working capacity of the lading line being 250 tons per hour, about four times that of the main line. The cars are filled by means of chutes passing from the dumping ground into a tunnel beneath, into which the cars are run. At the other end these travel out upon a pier, and discharge the cargo from above into the steamer, as shown in our illustration (Fig. 6). This pier is built upon a rock which projects some 400 feet into the bay. The illustration also shows the whole of the lading line. Near the left hand margin, about halfway up, is the exit of the charging station. In order to neutralize to some extent the sudden descent of the cliffs, four iron pillars are erected at a distance of about 20 meters (66 feet) apart, bearing three parabolic girders, which are continued toward the bay by a series of parallel girders supported on pillars spaced 10 meters (33 feet) apart. The last 20 meters (66 feet) of the line form part of the discharging station. When a car arrives here, its grip upon the traction rope is automatically released, and the contents of the car are shot directly into the hold of the steamer below, which is anchored to buoys. The ore chute can rotate about a horizontal axis and telescope to allow for the rise and fall of the steamer under the tide. This arrangement is of peculiar advantage as the Bay of Vivero is ill protected from the sea.

The following are some numerical data respecting the different lines:

The main line has a total length of 15,000 feet and a drop of 1,000 feet. Of this 5,400 feet length and 260 feet drop go to the upper line, and 9,600 feet length and 740 feet drop to the lower line. Line III. has a length of 2,828 feet with a rise of 340 feet, line IV. a length of 590 feet with a drop of 50 feet. The capacities of the lines are as follows:

Main Line from Monte Silvarosa to Dumping Ground on the Coast.—This carries 90 cars per hour, with a load of 67.5 tons, in 10 hours, therefore 675 tons. This figures out to 200,000 tons per annum. The velocity of the traction rope is 2½ meters (8 1-5 feet) per second, and the distance between two consecutive cars 40 seconds or 100 meters (330 feet).

Branch Line Lavandeira to Monte Silvarosa.—This has a capacity of 45 tons per hour, carrying 60 cars per hour with a load of 1,650 pounds each. The velocity of the traction rope is 2 meters (6 2-3 feet) per second, and the cars are one minute or 120 meters (396 feet) apart.

Loading Line.—The capacity of this is 250 cars per hour of one ton each. The cars are spaced 14 seconds or 21.6 meters (72 feet) apart and the velocity of the traction line is 1.5 meters (5 feet) per second. It is therefore possible to load 3,000 tons in 12 hours.

In consequence of the drop, no driving power is required, on the contrary a powerful brake mechanism is inserted in the line.

A PRISM FOR MEASURING THE ACTUAL DIP OF THE HORIZON.

A serious deficiency in the ordinary sextant lies in the fact that it measures the altitude of the sun above the apparent, rather than the actual, horizon. The usual "dip table," as it is called, corrects errors due to the altitude of the observer above sea level, but of course takes no account of variations in the apparent height of the horizon due to atmospheric conditions. The attention of Lieutenant-Commander John B. Blish, U. S. N., was particularly directed to this deficiency while on board a cable-laying steamer a few years ago. In order to accurately plot the location of the cable, most careful observations were made from early dawn until dark, sights being taken by nine experienced navigators. But on one bright day, when the horizon was seemingly perfect, all observations seemed to be wrong, and at noon the vessel was reckoned according to the sextants to be three miles north of the line on which it was supposed to be sailing. This was due to the fact that a change in the atmosphere had raised the apparent horizon above normal. As there was no means of ascertaining the amount of this change, the location of the cable was plotted on the chart by "dead reckoning" until the next day, when normal conditions of the atmosphere were restored. This incident suggested to Commander Blish the invention of a prism by which the actual dip of the horizon could be easily and accurately measured. This prism, as shown in the accompanying illustrations, has a rectangular cross section and the ends are beveled off to an angle of 45 degrees. The prism is entirely incased in aluminium with the exception of an opening located at each end of the longest face. It will be evident that a ray of light entering one of these openings or windows will be turned through an angle of 180 degrees, being reflected from one beveled face to the other, and thence out through the window at the opposite end. An observer holding the prism vertically before him, with the lower window on a level with his eye, will see the back horizon in the prism and the front horizon on either side of the prism, the two horizons being separated by the angle of twice the dip. With the prism attached to the sextant in the position illustrated, this angle can be measured by moving the index bar until the two horizons coincide. On taking a sight the prism is swung up out of the way, and the observed angle is first corrected for any error in the construction of the prism, after which the measured dip is subtracted, the remainder being the altitude above the true horizon. Experiments with the prism have shown the dip to vary as much as ten minutes of arc in five days, and that, too, with only slight changes in the temperature and barometric pressure.

The prism will also be found useful in pilot waters, enabling the navigator to exactly determine his line of position; for the observer will, obviously, be located on the straight line joining an object in the front landscape with one in the rear landscape appearing directly above in the prism. Such observations, though important, have not heretofore been much used, owing to the difficulty of making them. This simple prism should, therefore, prove of great assistance to navigation, offering, as it does accurate observations both for the harbor and the open sea.

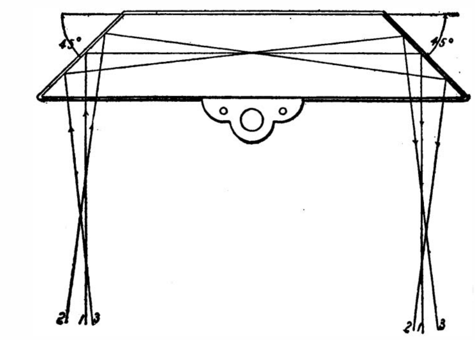


DIAGRAM OF THE PRISM.

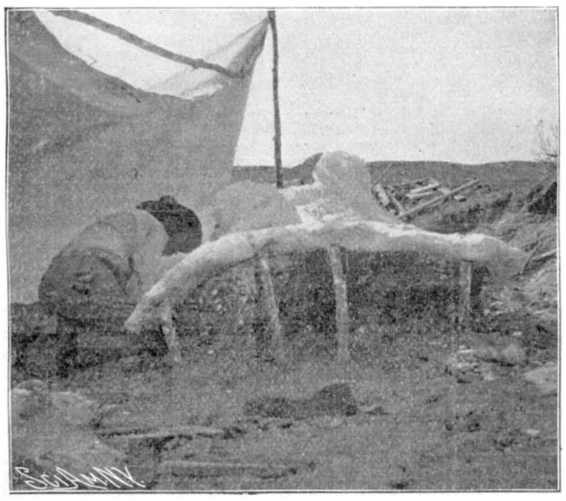
MEASURING THE ACTUAL DIP OF THE HORIZON.

J. E. Mills makes several interesting applications of the kinetic theory of gases. By considering the transition from the liquid to the gaseous state in a particular way, an equation is obtained in which all the quantities are measurable, and it affords an experimental test of the assumption that the molecular attraction varies inversely as the square of the distance from the molecule, and does not vary with the temperature. This assumption is found to be in agreement with the experimental data as tested by the equation. It is further shown in the paper that the molecular attraction differs from the attraction of gravity in being determined primarily by the chemical constitution of the molecule, and not by its mass.

A REMARKABLE FOSSIL DISCOVERY.

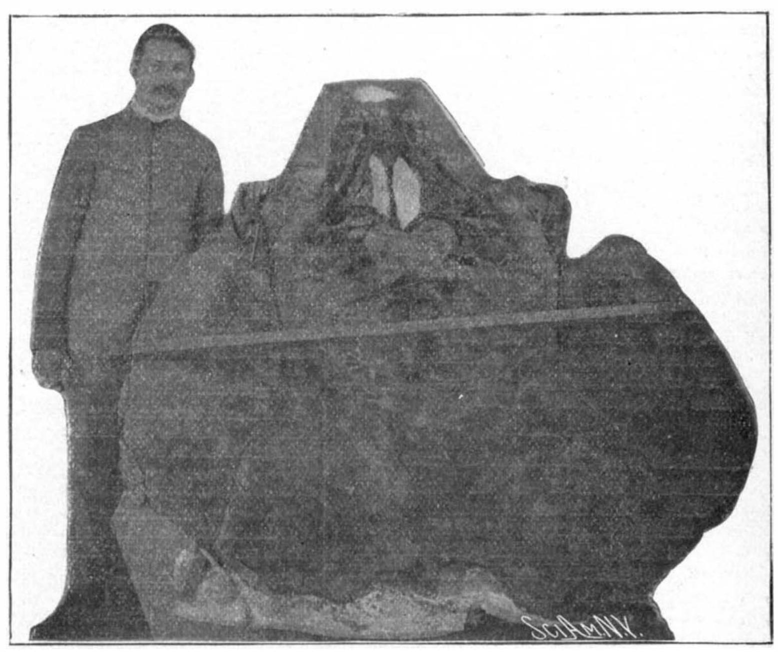
BY WALTER L. BEASLEY.

A recent fossil expedition of the American Museum of Natural History, sent out under direction of Prof. Henry S. Osborn, has succeeded in discovering the largest and most complete head of an extinct monster so far known. The find is considered a valuable contribution to science, being the record-breaking specimen of the world. The head in question was that of the mighty horned dinosaur known as Triceratops, said to have been one of the largest and most formidable



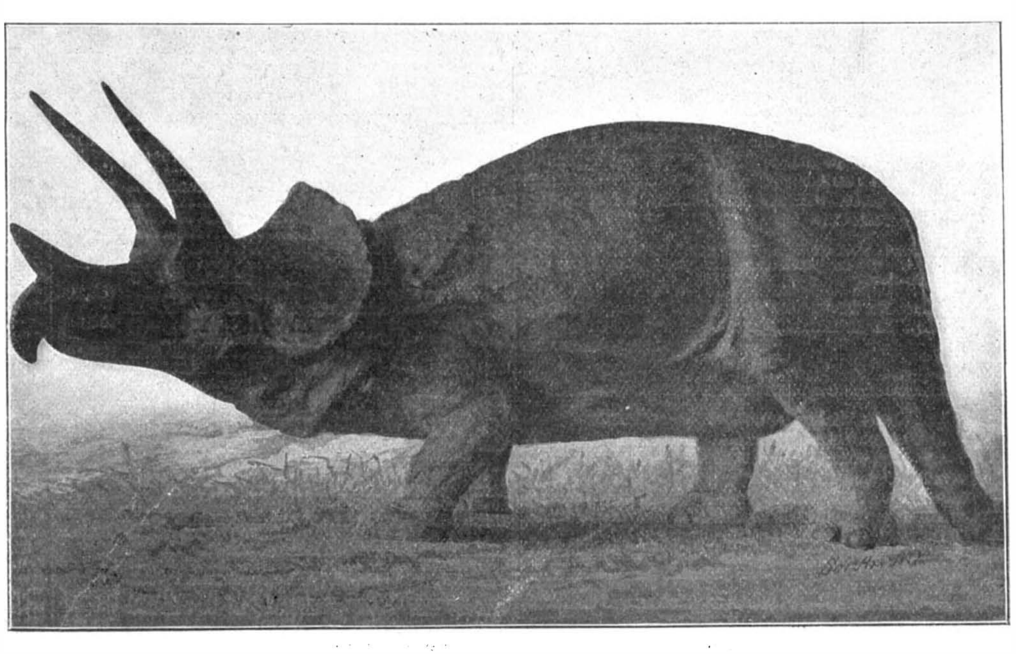
PREPARING THE HEAD IN MONTANA FOR SHIPMENT.

creatures which once roamed the shores of primeval earth. This gigantic reptile flourished and became extinct during the Cretaceous age, variously estimated to have been from three to ten million years ago. The enormous size and ferocious strength of the animal's head is vividly demonstrated from the astounding dimensions of the skull, which is seven and a half feet long by five and a half in width. There is a head in the National Museum in Washington which is only five and a half feet long and four feet wide. The skeleton of the animal in papier mache was exhibited at the Buffalo Exposition, based upon various fragmentary parts found. The inside portion of the skull, tipped at an angle of 45 deg., as shown in the accompanying illustration, strikingly sets off its great breadth and height in comparison with the standing figure alongside. With the exception of the upper portion of the horns, the skull was complete. The latter are to be restored. The digging up of such a large specimen practically almost intact is of unusual occurrence, and lends additional value to the find as an unequaled fossil treasure. The head was discovered by a party consisting of Mr. Branum Brown, of the Museum, together with Prof. R. S. Lull, of Amherst College, and Mr. Brooks, a recent graduate of that institution. The searchers, while reconnoitering along the banks of a small stream, a tributary of the Missouri, some 135 miles northwest of Miles City, Montana, came upon the weathered portions of one of the horns, slightly protruding above the surface. To the trained eye of the investigators this indicated fossil remains beneath or nearby, and careful examination shortly revealed the existence of the big head embedded in the sand strata below. This section of Montana, together with nearly all the area west of the Rocky Mountains, which in remote time was a great lake basin and inland sea, is now looked upon as America's vast prehistoric burying-ground, where are reposing the petrified remains of the strange and huge animals of the past. It took about four weeks to excavate and prepare the immense head for transportation to New York. This process required much skill and patience to satisfactorily accomplish. The earth was first cleared away, sufficiently enough to indicate the specimen. The whole skull was thereafter outlined and excavated by channeling around and beneath it. The sand and debris were scraped away with the utmost care from the bones. To harden and hold the remains together, and to keep the shattered sections of the skull in place, they were treated with a special chemical preparation, and cemented with glue. After being unearthed and braced by props, the upper and inside surfaces and edges of the skull were treated with several coats of plaster of Paris to strengthen and hold the bulky object firm during its long journey to New York. Three hundred pounds of plaster was necessary for this operation, being nearly the amount used in finishing the walls of an ordinary cottage. On leaving the field the specimen weighed 3,100 pounds, and required two hardy draft-horses to haul it to the railroad station. According to Mr. F. A. Lucas, of the National Museum, the beast is said to have been some twenty-five feet in length, and about twice the bulk of an elephant, weighing ten tons or more. A vivid glimpse of the animal in life is graphically depicted by Mr. Charles A. Knight's statuette, modeled under direction of Prof. Osborn. Mr. Knight is considered the best authority on painting and rendering in clay the various prehistoric animals of the past. The huge armored head and peculiar frilled skull are shown to great advantage in his model. The formation of the teeth clearly indicates that Triceratops was herbivorous, and did not chew or grind his food, but used his tortoise-like teeth for clipping and cutting the branches, twigs, and the various forms of tropical foliage upon which he fed. For a full meal, which probably required several days, it is estimated that he would consume from two to four hundred pounds of food-stuff. Intelligence did not go in keeping with his enormous size, evidenced by his small brain, which would not more than fill a good-sized teacup. His intuition was just about enough to defend himself from attacks made upon him by the large flesh-eating Dinosaurs of his time. When drawn into combat, owing to the extraordinary size of his head, and aided by his sharp and firmly-rooted horns, he is thought to have been practically invulnerable, and was unquestionably the undisputed master of the ancient brute world. That he carried on fierce warfare is forcibly shown by the skull in the National Museum, one horn of which is broken midway between the tip and base. It is supposed that the horn was broken during life, owing to the fact that the stump is healed and rounded over, while the other horn shows that the creature lived to a ripe old age. The fighting and savage side of the beast is, however, somewhat doubted by a few scientists, who hold that his bulky frame and slow-moving qualities indicate a comparatively peaceful animal, who fought only when set upon by enemies. In order to sustain the weighty body, the legs were short and massive. From the gradual taper of some of the skeleton parts of the tail previously recovered, it is inferred that the latter was round and did not serve for locomotion in water or balancing purposes. The various fossil expeditions planned by Prof. Osborn have probably been more successful in the size and number of specimens obtained than all other researches. Prof. Osborn proposes to supplement the unfinished labors of Profs. Marsh and Cope, who have revealed to the world the greatest series of extinct creatures, by mounting and exhibiting their specimens in New York. For the immediate working out of this problem Morris K. Jesup, Esq., has presented to the Museum the famous collection of fossil fish and amphibians discovered in Kansas, Colorado, Wyoming, Texas, and other portions of the great Rocky Mountain district between 1888 and 1896, by Prof. Cope. This new collection contains animals of all kinds, terrestrial, fresh-water, and marine, and covers the history of vertebrate life on the American continent, estimated by geologists at 17,000,000 years. Also the valuable Pampean collection, representing the Pleistocene fauna of South America, has been acquired. This was sent by the Argentine Republic to the Paris Exposition of 1878, and was purchased outright by Prof. Cope. For twenty years it has remained stored out of sight in the cellars of the Memorial Hall of Philadelphia. Through the generosity of some of the trustees, including H. O. Havemeyer, William E. Dodge, Prof. Henry F. Osborn, and others, the collection has just been presented to the Museum. The two collections together embrace about four thousand specimens, and when mounted the combined display of extinct life will surpass that of any other museum in the world.



LARGEST FOSSIL HEAD OF AN EXTINCT ANIMAL EVER FOUND.

Length, 7½ feet; width, 5½ feet. View of the interior.



RESTORATION OF TRICERATOPS BY C. A. KNIGHT.

How Chipped Glass is Made.

The ever-increasing use of forms of glass which will serve as a screen and yet admit a maximum amount of light, makes the study of their manufacture an interesting one. The form most generally used is known as chipped glass. In the manufacture of chipped glass the second grade is used; such imperfections as blisters or pimples, called stones, do not affect the quality of the finished product. The large sheets are first placed on a platform and passed slowly under a powerful sand blast of fine white sand, such as is used in glass making. In a couple of minutes they emerge with the glaze cut from the surface, and are known as ground glass, and much is sold in this form.

The sheets are then coated on the ground surface with a high-grade glue in liquid form, American or Swiss being considered best. They are then carried to the drying room and placed on racks, where they lie flat until the glue is well dried, which takes from twelve to fifteen hours. They are then placed in the chipping rooms, which are about five feet deep by six high, and as long as the size of the building will permit. They are divided by light frame partitions into spaces sufficient to admit two sheets of glass standing on edge with the coated surfaces outward. Coils of steam pipe run under the frames holding the glass, and when the heat is turned on, and as the glue reaches its driest point, it curls up in pieces from the size of a finger nail to a couple of inches long by an inch wide. The glue adheres so closely to the ground surface that in pulling loose a film of glass is taken with it. The result is the beautiful fern-like tracery, familiar to all who have noticed this kind of glass. About thirty-six hours is required for it to peel off clean, and thus complete the process of single chipping. For double chipping the glue is applied to the rough surface without sanding, as the surface is sufficiently rough to hold the glue. It is then passed through the same process, but the chips are smaller and break up the fern-like appearance of single chipped.

The secret of the process consists in the quality and preparation of the glue used, as none but the best will do the work. Also in having the draft and temperature right in the chipping rooms. Ordinarily a heat equal to a summer heat will do the work. The glue is cleaned and used repeatedly, as is also the sand. The sand after striking the glass falls into a pit underneath, and is carried up by the elevator.

The chipping process increases the value about half for single, and in the same proportion for double chipped. The Johnston Glass Company, of Hartford City, Ind., has a special department for this product, and ordinarily turns out about 100,000 square feet per month.

T. W. SHARP.

RECENTLY PATENTED INVENTIONS.

Engineering Improvements.

WINDMILL.—E. H. BENEDICT, O'Neill, Neb. Means are provided in this case to revolve a perpendicular frame freely. It is propelled by sets of fans which automatically open and shut so as to keep a full front to the wind no matter from where it blows. The pressure of wind upon these fans propels the frame in one direction. Power is communicated by two cranks one at each end of the frame rranged so that one pulls and the other pushes to alternate a perpendicular beam. A lever and shifting fulcrum give the plunger to the pump a long stroke in high winds, and a short one in low winds.

COMPOUND STEAM-ENGINE.—F. CAHA, Wahoo, Neb. The inventor's object in view is the production of an improved construction designed to secure an increased and uniform expansion of a motive fluid, a greater impulse from the same volume and pressure of a fluid, a reduction in the back pressure of the high-pressure cylinder during the return stroke of the piston therein, a decreased pressure on the steam-inlet valve, and the employment of short direct steam-passages to the working cylinders.

Of Interest to Farmers.

WIRE-STRETCHER.—J. É. HOWELL, Spearfish, S. D. Mr. Howell's improvement relates to that class of wire-stretchers employing a lever-and-ratchet mechanism to exert the necessary tension on the wire. The invention provides a means whereby considerable power will be effective to stretch the wire, while at the same time the operations of the lever-and-ratchet mechanism may be performed rapidly, the whole being arranged in a novel and convenient manner.

HEATER AND STEAM-GENERATOR.—O. R. RAND, JR., Smithfield, N. C. The design in this case is to provide a heater and steam-generator of improved construction by means of which the necessary degree of heat or moisture may be maintained in the tobacco-barn or pack-house during or after the curing of the tobacco to preserve the proper condition of the atmosphere as required by the tobacco at different stages.

WIRE FENCE.—B. B. WOOD, Helena, Mont. By certain novel constructions and combinations of parts the inventor secures a tie of the wires at crossings which will involve no exposed ends of the tie-wire and in which the tie-wire will be so made that when applied to a fence and properly handled it will form a practically continuous rigid tie around the joint with no exposed ends and will tend to bend the wires at the crossings equally.

Machines and Mechanical Devices.

RIMMING-MACHINE.—G. A. ENSIGN, Defiance, Ohio. This invention relates to wood-working machinery, and its object is to provide a new and improved rimming-machine, more especially designed for automatically driving or pushing wheel-rim sections onto the tenons of the spokes for cutting off the surplus portions of a rim-section to insure proper abutment of the ends of the rim-sections.

DRAG-SAW FRAME.—E. E. REDFIELD, Grants Pass, Ore. In the present patent the invention relates to a frame adapted to be engaged with and sustained on a log or other timber and to carry an engine and drag-saw in position for operation to saw the log. The saw and engine may be of any form, but concerning the engine the inventor prefers to employ the apparatus disclosed in a former patent granted to him for an improvement in engines.

Miscellaneous.

SWIMMING-GLOVE.—E. G. VANS AGNEW, Kissimmee, Fa. This inventor provides a glove for use in swimming, having a front portion and a back portion constructed to provide a double web portion between the compartments for the fingers and thumb and whose edge is reinforced to give rigidity at such point and which has a suitable outlet in its palm portion for the escape of any water that may get into the palm of the hand.

TACKLE-BLOCK.—T. E. MADDUX, Goldbar, Wash. The object claimed by the inventor is to provide a tackle-block with details of construction that adapt it for the free reception of a tackle rope at any point between the ends of the latter, to afford a block which permits the sheave to be readily removed, to provide a removable pintle-bolt for the support of the sheave, and to adapt the bolt to hold one of the hinged side walls of the shell of the block in closed adjustment, but permit its convenient release.

GAS-BURNER.—B. COLUMBUS, New York, N. Y. There is provision for a gas-burner in this improvement, which is simple and durable in construction and arranged to insure a perfect mixture of the air and gas, to allow of regulating the amount of gas to the minutest degree, and to permit of maintaining a pilot-flame of a mixture of air and gas whenever the valve-plug is turned into a closed position.

QUICKSILVER-FEED FOR AMALGAMATORS.—J. W. SWEARINGEN, Gaston, Cal. As quicksilver cannot be conveniently and certainly fed by any ordinary feeding device, this inventor has contrived a special form of feeding devices suited to the physical qualities of quicksilver and to the needs of the amalgamators, whereby it is automatically fed in regulatable quantities and at close and proper intervals, thereby making a great saving in gold and silver and in the millman's time.

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Write for anything you want made in metal novelties to Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 4428.—For machinery for wineries for making liquors, cordials, etc., also machinery for evaporating fruits and vegetables.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 4429.—For manufacturers of oil stills.

Bargain, 300,000 feet seamless steel tubing, 5-16 to 2 inches diameter. The Cleveland Distributing Co., Cleveland, O.

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Special and Automatic Machines built to drawings on contract. The Garvin Machine Co., 149 Varick, cor. Spring Streets., N. Y.

Inquiry No. 4431.—Wanted to manufacture some small article in France on royalty.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 4432.—For dyeing and steam cleaning machinery.

We manufacture anything in metal. Patented articles, metal stamping, dies, screw mach. work, etc. Metal Novelty Works, 43 Canal Street, Chicago.

Inquiry No. 4433.—For the address of the manufacturers of the packing box typewriter.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 4434.—For makers of hand and steam laundry machinery.

Contract manufacturers of hardware specialties, machinery, stampings, dies, tools, etc. Excellent marketing connections. Edmonds-Metzel Mfg. Co., Chicago.

Inquiry No. 4435.—For makers of machinery for manufacturing manila rope and cordage.

Matthews Torpedo Launches. Matthews & Co., Bascom, Ohio, U. S. A. Builders of high grade power boats.

Inquiry No. 4436.—For manufacturers of yeast mixing machines.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 4437.—For a machine for making artificial stone of cement.

WANTED.—Patent Office draughtsmen; only thoroughly experienced men need apply. Must show specimens of patent drawings. Munn & Co., SCIENTIFIC AMERICAN office, 361 Broadway, New York.

Inquiry No. 4438.—For manufacturers of fiber or papier maché that can be molded.

WANTED.—In large manufactory representing many trades, in a large city of the West, superintendent of technical education and of experience in handling men. Address, with full particulars, Mechanic, Box 773, New York City.

Inquiry No. 4439.—For the address of the manufacturer of the patented skirt supporter called the "Little Gem."

Patent No. 732.675, improvement on fork for sale or on royalty. M. K. Kelter, No. 507 South Market St., Wilmington, Delaware.

Inquiry No. 4440.—For manufacturers of machines, outfits, etc., for making gravel ready-roofing.

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NEW BOOKS, ETC.

GAERUNGS-ESSIG. Von Paul Hassack. With 75 illustrations. Vienna: A. Hartleben. 1903. Crown 8vo. Pp. 408. Price, $3.

Mr. Hassack is a well-known New York vinegar expert who has in this work embodied his experiences in an industry with which he is thoroughly familiar. His first chapter gives a general idea of what a vinegar factory should be. In his second chapter he discusses the generator. How the generator should be operated is made the subject of the third chapter. In the fourth chapter, which is chemical in its nature, the methods of testing and controlling the production are treated. The difficulties which must be encountered and which must be overcome are discussed in the fifth chapter. "Ferments and Nutriments" is the title of the sixth chapter. In the seventh chapter the filtration of vinegar is described. Wine vinegar and new generator types are respectively the subjects of the eighth and ninth chapters. An admirable index completes the work.

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"Horizontal Tandem Full Housing Fans," for mechanical draft apparatus, Buffalo Forge Co. 783
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"Influence of the Temperature of Air," for mechanical draft apparatus, Buffalo Forge Co. 776
"Mum(m)'s the Word," for liquors, Keller, Loomis & Co. 768
"Nu-lectric," for medicine, Nu-lectric Chemical Co. 770
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"Performance of Steel Plate Exhausters," for mechanical draft apparatus, Buffalo Forge Co. 773
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