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.

Fig. 1.—Mars on May 29, 1890.

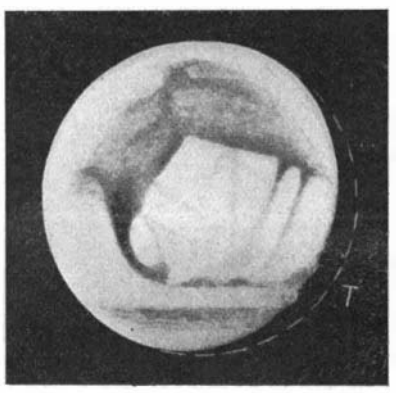

Fig. 2.—Mars on July 6, 1890, Showing Protuberances.

PHOTOGRAPHS OF MARS TAKEN WITH LICK 36-INCH TELESCOPE.

### 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.

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.