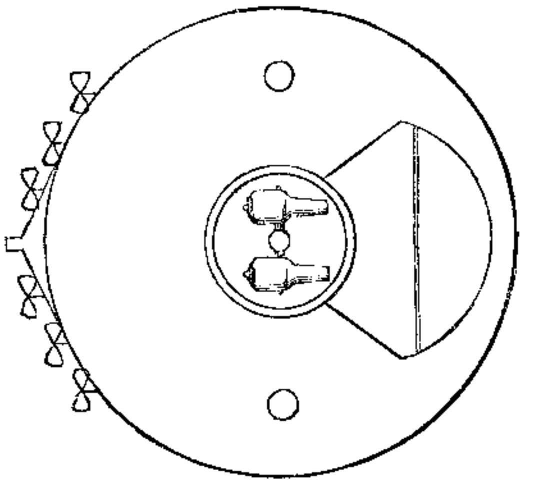
CIRCULAR SHIPS.

The idea of circular vessels is not absolutely new. Probably the earliest practical suggestion was that of Mr. T. R. Timby, of Worcester, Mass., who, in 1843, filed in a working model of a revolving ship, together with specifications, in the Patent Office at Washington. His plan embraced circular ships and revolving ironclad forts and turrets, which have since come into use.

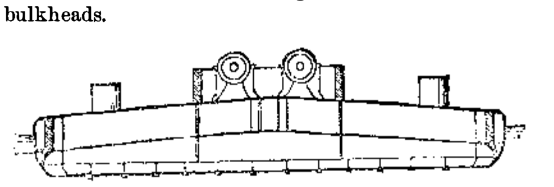
Admiral Popoff, of the Russian navy, has also adopted the idea, and quite recently two vessels, the Kiew and the Novogorod, have been successfully launched at Nikolaief.

We lay before our readers, in the accompanying engravings, sectional and plan views of these curious ships, from the pages of *La Nature*. Each vessel is 99·2 feet in diameter and constructed of iron, planked with wood and sheathed with copper. The draft of water is 12·1 feet, and the spar deck is 2·1 feet above the water line. The displacement is 2,783 tuns. The bottom is perfectly flat, and the sides are vertical, with an overhang aft, sheltering the rudder. In order to insure stability, twelve keels are affixed, each about three inches in depth.



At the center of the ship is a turret, 29 feet 6 inches in diameter and 7 feet high, containing two 11 tun steel guns (probably eight inch bores), breech loading and mounted *en barbette*. The turret has a hollow axis which serves as an ammunition scuttle, and on which pivot the supports of the guns, so that the latter can be pointed over an angle of from 30° to 35° with the fore and aft direction of the ship. The rest of the armament consists of torpedo arrangements.

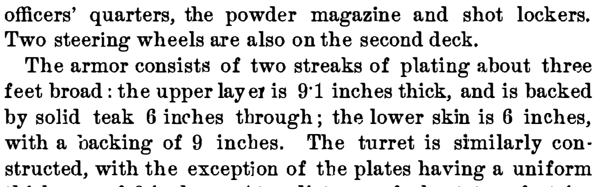
The lower portion of the hull is double, and there is a space of about 2·9 feet between the shells. The lower plating is ·62 inch in thickness and the upper ·23 inch. The hold is divided into a large number of watertight compartments. Parallel to the upper deck and about 6 feet below, is a second deck, both being united to the lower shell by bulkheads.



Forward of the turret is a light superstructure serving as a protection against the sea and as quarters for captain and other officers, eleven persons in all. The second deck comprises a forecastle for the crew of ninety men, and furthest aft the coal bunkers and boilers, each of the latter having a separate smoke stack. Amidships are other officers' quarters and a powder scuttle. There are six eighty horse power engines, built on the Woolf system, each driving an independent screw. Machines and boilers together cost $222,000, about. Below the forecastle are storerooms; and under the officers' quarters, the powder magazine and shot lockers. Two steering wheels are also on the second deck.

The armor consists of two streaks of plating about three feet broad: the upper layer is 9·1 inches thick, and is backed by solid teak 6 inches through; the lower skin is 6 inches, with a backing of 9 inches. The turret is similarly constructed, with the exception of the plates having a uniform thickness of 9 inches. At a distance of about two feet inside the walls of the ship is a watertight bulkhead formed by ·7 inch plating, dividing the battery into two parts, so that in case water should enter one of the exterior compartments, the vessel would still float.

The trial trip of the *Novogorod* was recently made at Nikolaief in presence of the Grand Duke Constantine of Russia. Although the ship was hardly completed, or entirely ready for sea, it is stated that, with a steam pressure of 5·2 pounds, and a vacuum of 21·4 inches, with 62 revolutions, a speed of six knots per hour was obtained. The ship proved herself an excellent sea boat, obeying her helm readily, and turning almost squarely on her heel when the engines on either side were stopped or their speed slackened. With the port engines going ahead and the starboard engines backing, it is stated that she went about the first time in two



minutes, and on a second trial in one minute and nineteen seconds, without hardly changing her place. On reversing both machines, the ship stopped in a few seconds and turned in the opposite direction, also without altering her position.

Correspondence.

The Hair Worm.

To the Editor of the Scientific American:

The following, apparently cut from some book, was sent to me for solution: and, if agreeable to you, I will answer it through your columns. It reads thus:

"A CURIOSITY FOR NATURALISTS TO SOLVE.—Mr. J. H. Horsford writes us from Freedom, Ill., that a horse, owned in that country by a Mr. West, has a worm or snake in his left eye, from two to two and a half inches long, and, to appearance, of the thickness of a small oat straw, squirming with the active motion of a large snake. The horse, he says, has evidently lost the sight of his eye from his snakeship having taken up his abode there; and it is only about a week since there appeared any difficulty to the eye. He thinks it has been produced by a hair getting in by some means, and changed to a snake, as hairs are known to do in water. To know its wonders is to see it, as it can be plainly, a rod from the object, wriggling about as if too much confined. *Query:* How came it there and what will the result be? Let some of our veterinarians answer."

I hoped that the old notion that a horse hair will turn into a snake had been obliterated years ago. I am surprised that any one should advance such a theory, even in this Darwinian age.

The hair snake, so called, is frequently met with; I have taken them from grasshoppers, from an apple, from a head of cabbage, swimming in the gutter along the curb of our city. I have found them in our streams and in our spring water, of various lengths and shades of color. Indeed, it seems to me, everybody ought to be familiar with the *gordius*, or hair worm, which, in my youth (as I was taught the common notion), I thought was a transformed horse hair. They are so perfectly hair-like in form that it is not very surprising that ignorant persons might so mistake them. Yet the two sexes are readily distinguished. In the male, the tail end is bifurcated, in the female trifurcated (at least in the American species). I have found the female coiled or indeed knotted up, suggestive of the Gordian knot. Could its name be derived from Gordius, king of Phrygia? If so, I am not aware that I ever met with the statement. After carefully unfolding, I discovered that it had within its folds a string of eggs, like beads, in a bail, and seemed tenaciously attached to them, gathering them up carefully, again to take them under protection. The female deposits millions of these eggs, connected in a string. These, in the course of three weeks, hatch; when the embryos escape from the eggs, they are of a totally different form and construction from the parents. Their bodies are only the $\frac{1}{450}$th of an inch long and consist of two portions: the posterior cylindrical, slightly dialated and rounded at the free extremity, where it is furnished with two short spines; and the anterior broader, cylindrical, and annulated, having the mouth furnished with two circlets of protractile *tentaculæ* and a club-shaped proboscis. I am indebted for some of these details to the patient investigation of Mr. Joseph Leidy, M.D., of Philadelphia. He also says: "No one has yet been able to trace the animal to its origin, or what becomes of the embryo in its normal cyclical course," as those he had observed always died a few days after escaping from the egg. These *gordii*, when developed, vary in their length from three inches to a foot; they occupy various positions among the viscera and even in the head, including the muscles, for their living habitation, analogous to the *trichinæ*. And so minute a larva can as well get into the eye of a horse as into the muscles of an insect or animal.

Among the known *entozoa* that infest man is the *monostomum lentis*, of Gescheidt, found in the crystaline lens, and the *distomum oculi humani*, in the capsule of the crystaline lens, others of this latter genus, *d. hæmatobium*, in the tortal vein, and *d. heterophyes*, of Siebold, in the small intestines. To refer to the snake in the horse's eye, then. It is simply this: The minute animal just hatched (the *gordius* is common in streams, where horses may drink or be washe in the water abounding with the minute embryos of the hair worm) could cling to and penetrate the crystaline lens of the eye, and develope into the *gordius*, which may require some living tissues for its development, or if more carefully examined, might prove some other specimen of the entozoa.

I was more astonished to find a *gordius* in an apple; true, it was worm eaten, but I can advance no theory how it got there unless it crept from a dead grasshopper into the apple or hatched in the blossom and developed with the fruit. A shower of rain could easily scatter the eggs or minute embryos. J. STAUFFER.

Lancaster, Pa.

The Variable Star Algol.

To the Editor of the Scientific American:

The periodical fluctuations in the light of the star Algol have been accounted for in two different ways, first, by supposing that a non-luminous body revolves around this star, the plane of its orbit being directed toward our system, or nearly so, and secondly, on the hypothesis that Algol is a secondary body, revolving round a dark primary in an orbit situated as in the former case.

If the variations are really produced by the intervention of a dark body, and if, at the time of minimum brightness, their dark body is entirely projected upon the disk of Algol, it is evident, from the large proportion of light cut off, that the two bodies do not differ very greatly in size. It seems to me, therefore, that if we admit the existence of a dark companion, it would be more correct to say that both bodies revolve around the center of gravity between them, rather than to say that either of the two revolves around the other.

There is a method of observation at our command, however, by which the truth of this theory of Algol's motion in an orbit, may be put to the test. I refer to spectroscopic observation. In case Algol moves in such an orbit, it is obvious that, at times, it must be approaching our system, and at other times receding from it.

If, therefore, the orbital velocity of the star be sufficiently great, displacement of the lines in its spectrum would result; and by observing the amount of their displacement at different times during the period of variation, the rate at which the star moves in its orbit could be determined, approximately. Of course, in these observations account would have to be taken both of the proper motion of the system from or towards us, and of the orbital motion of the earth.

Spectroscopic observations of Algol, and of other variable stars as well, if conducted in this manner, would, in all probability, lead to the most interesting results.

St. Catharine's, Ontario, Can. J. M. BARR.

Mexican Water Coolers and Filters.

To the Editor of the Scientific American:

In your issue of June 14, you have given a drawing of an Australian water cooler. That is very good for the purpose; but herein you will find a sketch of those used in this country to stand on a table, which are far prettier and more convenient. They are made of red, white, or buff colored clay, with saucers and stopples to match. Many of them are ornamented with wreaths of ivy, or bouquets of flowers in colors. The necks, stopples, and saucers, are glazed; the bodies are left porous. The white and buff become discolored sooner than the red. The latter are very pretty when made of the finest clay.

In this country there is a stone which is used for filtering water for domestic use, and I am sure that it is better than anything gotten up in the United States for that purpose. It is indurated volcanic ashes. The stone is cut in the form of a hollow, inverted pyramid, the smallest size being about 15 inches at the base, 22 inches deep outside, and 2 inches in thickness, the last dimension increasing as it approaches the apex, with the exception of being cut away near the base on the outer surface to form an offset by which it is suspended in a frame. Beneath this, upon a shelf in the lower part of the frame, six or eight inches from the floor, is placed a very thin, unglazed, earthen jar to receive the water as it drops from the stone. This jar is covered with a plate having a hole in the center, upon which rests a small, unglazed pitcher.

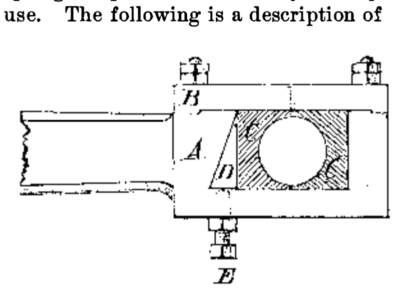
Turbid water passes from the filter as clear as crystal, remains in the jar deliciously cool, and is much more wholesome than ice water. The latter article is rarely used here, as our only sources for the supply of ice in this valley are artificial, and the peak of Popocatepetl. S. E. G.

City of Mexico.

Taking up the Wear of Journal Boxes.

To the Editor of the Scientific American:

In Mr. Crawford's suggestion, published in your issue of September 6, I see no way to take up the wear of the boxes, caused by the end strain that the rod is subjected to. I herewith send to you a sketch of a plan for which I am indebted to Mr. Charles Elms, of Chicago. I have used it, and find it a very convenient, cheap and substantial method of fitting up stub ends, answering all purposes of the strap, gibs, and key, and in some respects better to those, as there are no spring straps and battered keys to repair after a few years' use. The following is a description of the invention: A is the stub end; B, plate or cap fastened at each end by a stud, an offset fitting a corresponding one upon stub end A; C C are brasses; D is a steel wedge to take up wear of boxes or brasses, adjusted by the stub set screw, E.



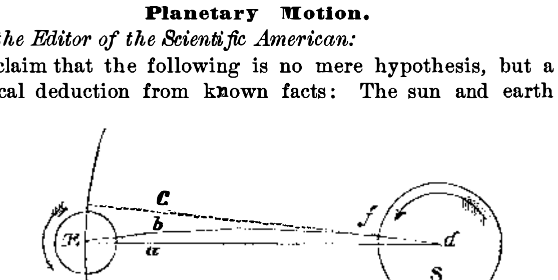
Having been benefited myself by many suggestions and much information received from your valuable paper, I submit this to you, hoping that it will be of some use to my fellow draftsmen and machinists.

New York city. ROBERT C. GRAY.

Planetary Motion.

To the Editor of the Scientific American:

I claim that the following is no mere hypothesis, but a logical deduction from known facts: The sun and earth



tend to approach each other, obedient to the laws of gravitation existing between them. This gravitating force is instantaneous, and its direction is indicated by a right line drawn through the centers of the earth and sun. If it were not for an opposing force, they would approach each other with an accelerated velocity. Such a force exists in and is radiated from the sun in all directions, and is made manifest to us by certain well known physical phenomena.

This force is not instantaneous, but it requires time to act through space. The sun revolves upon its axis: consequently the direction of a force radiating from the sun and requiring time to act through space would not be indicated by a right line. For convenience of illustration, we will suppose that the planes of the earth's and sun's equators coincide. Let S and E, respectively, represent equatorial sections of the earth and sun: then *a* will be the line of direction of their attractive forces. If the sun be at rest, the direction of force emanating from the point, *f*, on the sun's equator would be indicated by the dotted line, *c;* but, as the sun revolves, this force, which requires time to act through space, will be deflected in the direction of the curved line, *b*. This line, *b*, is the center of direction of the force projected from the sun and acting in oppositon to the attractive force. I should have said that the arc of the sun's equator, intercepted by the angle, *a d c*, is equal to the distance traversed by a point on the sun's equator during the time required for the transmission of this force to the earth. This curve will be increased by the amount of the earth's orbital motion for a like interval of time. Now with your knowledge of mechanics, you will see at a glance the inevitable consequences of this slight difference in direction of these two opposing forces. Slight as it is, it is more than sufficient to account for the movement of the planets, as it will explain other questions. Now lay down an axial section of the sun and project the curves caused by the centrifugal force: the axis and equator will be represented by right lines: but from the intermediate degrees all the lines will be deflected towards the equator, the curves shortening as we leave the axis. In this we have an explanation of the cause of the planets being confined to the zodiac. I have forwarded substantially the same communication to three eminent astronomers. JOHN LINTON.

Baltimore, Md.

REMARKS BY THE EDITOR.—The nebular hypothesis finds general acceptation at present. The solar system is supposed to have been originally a nebula or vapor cloud of unequal density. Such a mass, in condensing by the mutual attraction of its particles, would rotate with increasing velocity. Rings of vapor thrown off, or rather left behind in condensation, formed the planets. The planetary nebulæ themselves throw off rings, forming their satellites and, in the case of Saturn, a multitude of asteroids. As force is as indestructible as matter, and as light, heat, motion, electricity and chemical action are convertible terms, the planets, resisted by the ether of space, will fall to the sun, and the solar system will ultimately resume its original gaseous form.

A sphere of oil, supported in a mixture of alcohol and water of the same density, and set whirling by introducing a rotating disk near its equator, flattens at the poles and throws off rings which form revolving satellites, in a very instructive manner.

The Proper Length of Crank Pins.

To the Editor of the Scientific American:

In your issue of September 27, I find just the thing I have been looking for for years, namely the proper rule for the size of a crank pin of an engine, as laid down by Theron Skeels, C. E. I think the rule beautiful in the extreme, and so simple that any one ought to understand it. Yet there are one or two things that are not fully clear to me, but this is probably from a lack of education on my part. The last part of his rule says "multiplied by a coefficient which is determined by an experiment." If we are to find out, by experiment, this point, why not the whole thing?

It seems to me that there may be more causes than the one named. In practice, we first look to see if the box is not too tight, and second, if the pin is in line with the main bearing. Then we see that the cross head does not twist this connection on the pin, next that it is well lubricated, and that the oil or lubricant is strong enough to stand the work. After going through the whole of these and finding all right, then we look to see if it be of proper size, and this, I opine, is and always will be determined by experiment, for engines of equal indicated horse power will need different sized pins.

We have one engine running made by George H. Corliss, with cylinder 18 × 30 inches, shaft 8½ inches diameter, crank pin 4¼ inches diameter, and 7 inches long. This runs, with steam at 125 lbs. at 100 revolutions per minute and comes to full stroke probably 500 times per day, then off to nothing, passing many strokes without steam at all. After two years, use, there is no appreciable wear and no heating. We are making another like it, thus using the last part of Mr. Skeels formula and not infringing his rights by using the first.

Syracuse, N. Y. W. A. SWEET.

NEAR Delaware Water Gap, Pa., there is a cave in the face of Mount Minsi, opposite the river, whence issues constantly, with considerable force, a current of cold air. A small stream of water issues from the cave. It has been ascertained that the water trickles down from the roof of the cave, and the cooling of the air is supposed to be due to contact with the wet surface of the roof.

AN advertisement in the special sixty thousand edition of this paper, soon to be published, will reach a class of persons not accessible through the ordinary channels of newspaper advertising. See announcement on another page.

The Great Oil Wells of the United States.

The committee sent by the prophet Moses to enquire into the resources of Canaan, reported that it was a land flowing with milk and honey. But even if that ancient country had been veritably blessed with natural deposits of the substances mentioned, it is questionable whether its richness could have equaled the wealth which this country enjoys in her natural oil wells.

The total oil product is now 34,560 barrels of 42 gallons each, every day.

The number of producing wells in the entire oil region of Pennsylvania is about 5,000, and the average daily product per well is 7 barrels.

A correspondent of the New York *Tribune* gives the following interesting information:

BOUNDARIES OF THE OIL DIGGINGS.

The northern extremity or rather the two northern extremities of the oil producing region are in the vicinity of Titusville and Tidioute, Pa., from which points it extends in a southwesterly direction along the Allegheny River, though not following its course strictly, down to Greece City and Millerstown, a distance in a straight line of about eighty miles. The "Old District" begins at the north, as given above, and ends at Parker's Landing, on the Allegheny River, and comprises most of the old famous wells, including those of Pithole, which have figured so conspicuously in times gone by. The "New District" begins at Parker's Landing and extends down to and includes the new wells of Modoc. The entire district is a rough farming country, and is traversed with lines of hills which, though not remarkable for higbt, are of mountainous character. Here and there are towns which, though of moderate size, are "cities," those of Titusville and Franklin being the finest.

THEORY OF THE OIL ROCKS.

The present accepted theory in regard to oil-producing rocks is that they lie in series of belts, the general trend of which is from twenty-two to twenty-three degrees east of north and west of south. But there are minor belts that seem to run across the great belts, and even the most experienced oil men are not very certain of the accuracy of their theories. One who has never visited this country is apt to fall into the error of supposing that the number of wells that have been sunk is quite limited; but the fact is that they may be numbered by thousands. They are seen everywhere, on hill and mountain, in valley, in mid river, in town and in country. And as most of these wells have gone to decay, and but very few are yielding enough oil to pay, and as it cost originally from $5,000 to $10,000 to drill each of them, some estimate may be arrived at of the amount of capital that has been dissipated.

HOW OIL WELLS ARE SUNK.

The business of drilling wells has now fallen almost entirely into the hands of professional drillers. When a man or a company has decided upon a well, and selected its site, the first step taken is to put up a derrick, or, as it is termed here, a "carpenter's rig." This is a framework, made mostly of plank, from 65 to 75 feet high, about 14 feet square at the bottom, and running nearly to a point at the top. The cost of a derrick is about $800. The tools used in drilling are the bit, which is like any ordinary rock drill, but larger, being about three feet in length; above that is the auger stem; then two chain links called the "jars," and above that the "sinker bar." This is attached at the upper end to the rope which passes over a pulley at the top of the derrick, and thence down to a large windlass outside of the derrick. The drilling is done by a steam engine with a crank movement, which keeps the drill at work day and night, a man standing by in the derrick to give the tools more rope at proper intervals, and to turn the drill while it is operating. After the drill has reduced a certain quantity of rock to sand, it is drawn from the well up into the derrick, and the sand pump is lowered and the sand is brought out, when the drill is again inserted. The rope used must be of the very best quality, and in digging deep wells it requires two ropes, as the sand very soon cuts them out. The expense is a very considerable one, being $400 for each rope. The tools for drilling that are now used weigh 1,800 pounds, those that were first used weighing only 90 pounds. A good set of drillers will put a well down in about 65 working days, provided they have good luck and no accidents; but it oftentimes takes six months to reach the oil sand.

ENORMOUS DEPTH OF THE NEW WELLS.

The rock in which the oil is found has a very decided dip from the north to the south, it being about sixteen feet to the mile. In the old or northern part, it is found at a depth of from four to seven hundred feet, whereas the new wells at Modoc are from fourteen to seventeen hundred feet deep, the expense of drilling one of the new wells being nearly double that of one of the old ones. The drillers generally know where they are by the kind of sand that they bring out.

CHARACTER OF THE SEVERAL ROCKS.

At Modoc, at a depth of about five hundred feet, they strike what is called the mountain sand rock, down to which they bore an eight inch hole. Here they know that they are below all fresh water, and they put in a casing, down to and resting on that rock, with an inside diameter of 5⅝ inches. From there they bore, through the casing, the remainder of the well with a diameter of 5¼ inches, depending upon this shoulder of rock at the bottom of the casing to shut off the salt water, which is sometimes found in large quantities. The next sand rock of importance that is found is called the second sand, which lies at a depth of a little over twelve hundred feet and sometimes produces oil. This, however, is not considered a good sign, and makes future drilling operations on the same well rather gloomy work, as a first class well cannot be expected. The fifty foot sand rock comes next; the next is the bowlder; then comes the corn meal sand, so called because of its resemblance to corn meal. From that you get five to ten feet of slate, and then you strike the oil sand, which is a sort of pebbly rock; and if the well is going to amount to anything, oil appears the moment you penetrate or even scratch this rock. Between these strata that I have mentioned, the space is filled up mostly with shells, slate, soap rock, sand, etc., the drilling being very easy. But in the sand rocks above enumerated, slow time is made by the drillers; and the mountain sand is so hard that it wears the drill, and the particles of steel from the bit are very perceptible among the grains of sand.

THE NEW WELLS AT MODOC.

The stream of oil from a flowing well is not continuous, but comes in pulsations, with occasional intermissions of entire stoppage of greater or less length. A good flowing well runs at first with great force, and the yield of oil is accordingly great, but it gradually decreases in production until it ceases to flow at all, and thus it must be pumped, after which the supply goes on decreasing until its yield will not pay the expense of pumping, and then it is shut down. It therefore requires ordinarily the constant drilling of 400 wells to hold the production up to the level of the demand. But at the present time all drilling must stop except in the neighborhood of Modoc, because nothing less than a 200 barrel well will pay back to the owner the first cost, $8,000 to $10,000, with oil at the present prices, 80 cents per barrel at the wells. Wells that will yield 200 barrels a day are found only at long intervals, Modoc being at present the exception to this rule, and the richest oil deposit yet discovered in Pennsylvania.

The first well that was sunk at Modoc was the Troutman well, which was struck last March. At first it averaged about 950 barrels a day, and it turned the attention of oil men in that direction. It, however, stood alone for over four months before any other wells were finished. Its present yield is about 300 barrels a day, and it is considered as holding out remarkably well. In July a number of other wells were struck, among which two of the richest were the Walt Thompson and the Dean & Taylor wells. Their yield is now estimated at 650 barrels each per day. There are at this place 16 wells, all lying within a square mile, which now average 500 barrels each every twenty-four hours. The reports that the new oil wells of Modoc are materially falling off are not correct. It is the opinion of good experts that the yield of oil is even greater than it is reported to be by the producers themselves. I saw wells that were said to be giving 500 or 600 barrels a day which had every appearance of yielding 1,000 barrels a day. As a large number of new wells are being drilled in this deposit, the producers, being anxious to keep the price of oil as high as they can, are evidently underestimating the capacity of their wells.

PRODUCTS OF THE VARIOUS DISTRICTS.

Of the 34,560 barrels of oil now daily obtained, the First District, which is the latest development and includes all the big wells, furnishes 18,560 barrels, the Second District 2,500 barrels, the Third District 4,500 barrels, and all the other districts, containing the wells that furnished all the oil previous to 1870, 9,000 barrels, making a total as above stated of 34,560.

THE PIPE COMPANIES.

As is well known, all the oil is delivered from the wells to the delivery tanks on the railroads through pipes. These pipes are laid generally upon the surface, and they run through valley and over mountain, and under rivers, the oil being forced through them by steam power. The longest pipe now in use is about 15 miles in length.

The Bridgeport Shirt Factory.---The Howe Sewing Machine Works.

A correspondent in the *Commercial Advertiser* gives the following interesting account of his visit to some of the extensive manufacturing establishments in Bridgeport, Conn:

Burlock & Co., large shirt manufacturers, the writer states, employ about six hundred hands, and make one hundred dozen shirts per day, consuming three thousand yards of muslin and seven hundred of linen each day, and $9,000 worth of thread every year. One hundred sewing machines are constantly running, from seven o'clock in the morning until eight in the evening. These machines are worked by steam and managed by young girls, the majority of whom are skilled performers; some of these experienced hands earn as high as $75 per month. Every part of a shirt is manipulated by different hands; each piece is finished in a room designed for the kind of work. It takes sixty women to make all the parts of a shirt, and yet it only requires two minutes to make this all important garment. From the time the cloth is first brought into the cutting room, there is no rest for the fabric; it is tossed about with lighting speed; the changes made from one to another are really marvelous, and, before you get over your surprise, the shirt is ready for the laundry, where it again flies about without stopping until it reaches the inspecting room, where it is allowed to rest a few minutes, when it is carefully looked over, and, if there is the slightest flaw found anywhere in its manipulation, back it goes to the department where the defect was made. We remained some time in the ironing room, and were much amused to see the way the women ironed the bosoms, collars, and cuffs. The irons are heated almost to a red heat; they are passed over the linen with very great rapidity, which is no sooner dried, than the ironer again wets the linen and takes another red hot iron. This drying and wetting process is repeated several times before the linen presents the desired glossy appearance. We asked Mr. Perkins what the secret was of putting on this much admired polish. The gentleman smiled, and said: "It is nothing but elbow grease."

After seeing how much labor and scientific work it takes to make a shirt, we drove over to East Bridgeport, and were escorted through Howe's sewing machine factory. This building has a front of 1,256 feet; it is five stories high, and employs 1,500 workmen. They make 500 hundred machines per day. Every part of a sewing machine is a branch of work by itself, and is manipulated in a separate room under the charge of a foreman. We were very much interested in the needle department, which is under the charge of Mr. Thompson, a very pleasant and affable gentleman, who kindly gave us many points of information. Twenty thousand needles are manufactured in one day. One hundred and eighty men and woman are employed in this department. From the wire steel coil up to the time when the needle is ready for use, it passes through fifty different hands.

LETTER FROM UNITED STATES COMMISSIONER PROFESSOR R. H. THURSTON.

NUMBER 16.

PARIS, September, 1873.

Since the date of the previous letter, we have made an excursion into South France, visiting the immense iron works of Le Creusot, and the great and busy city of Lyons. Our trip has occupied only four days, but we have seen and learned a great deal and have experienced much pleasure in that short period.

During the year 1872, the total quantity of cast iron produced in France is reported as 1,181,262 tuns, of which more than one million tuns has been produced by the 113 blast furnaces which use coke fuel, and 178,571 tuns were the product of 115 furnaces using charcoal. The production of steel is given as about 140,000 tuns during the same year, the amount having doubled in the short space of three and a half years, and nearly trebled in about four years. This production is the result of the united labor of many establishments; but a single one, that of Le Creusot, is sending into market one third of the whole, and we should hardly have been justified in leaving France without visiting this place, even had it compelled far greater expenditure of time, money, and physical energy than it has demanded. We were also bound by our acceptance of the courteous invitation of its hospitable proprietor, M. Schneider, whom we had met as a colleague at Vienna.

The day before leaving Paris on this expedition, we visited the locomotive engine building establishment of

CAIL & CO.

on the Quai de Grenelle, near the Champ de Mars. We found there a fine collection of shops, employing between three and four thousand men in the manufacture of locomotives and of general work. We were received here with the utmost kindness and courtesy, as we have been at all of the great manufactories that we have desired to visit, with the single marked exception of that of Krupp, at Essen. The workshops of Cail & Co. cover an immense extent of ground just outside the city of Paris. They are all of one story in hight, the roofs are supported by iron columns and girders, and the interior is generally well lighted and ventilated by windows in the roof.

The transportation of material from one part to another of the works is effected by cars upon a railroad track leading to all the workshops, the traction power being obtained from several light locomotives. In the setting-up shops, traveling cranes are well placed, and are in constant use. The work is generally very good, although some pieces were hardly as well finished as was the average of that which had passed inspection, and it would not have been passed as satisfactory in our own leading shops. The boiler work was quite good. We noticed one riveting machine here, but it would not compare favorably with those that we have seen elsewhere. In the forge shop the work was good. The heaviest steam hammer was said to have a drop weighing 800 kilogrammes—1,760 pounds. Judging from the fact that there were a hundred draftsmen employed, we should conclude that work is not as well systematized as it should be in such a place, or as it is in our own establishments of this kind, and that alteration of designs must absorb a heavy percentage of the profits. It is possible that the variety of work done by Cail & Co., which includes sugar mill work and every variety of machinery, may be good cause for the employment of so much profit-consuming labor. We were pleased to find here a neat chemical laboratory, an auxiliary too seldom appreciated by iron works proprietors.

Taking the 11 A. M. train from Paris, an express running through to Marseilles, we enjoyed a very pleasant ride through the heart of France, arriving at Le Creusot at 9:30 P. M. Our route, almost from Paris to the end of our journey, lay through the beautiful and rich wine-growing districts, of which the produce is sent to all parts of the world. From Verrey to Dijon and Chagny, we were delighted with the beautiful scenery of the

CÔTES D'OR,

where are raised the finest wines of Burgundy, and which district is given its name from the exceptional value of the product of its vineyards. The common table wine of this country, which would, with us, be considered a good wine, sells for about twenty sous a bottle, while the price of the finer brands of the *Côtes d'Or* is ten francs here, and probably nearly as many dollars in New York, if it is possible to obtain them at all in all their native purity and strength. Both red and white wines are raised, but the red are generally most liked and are best known abroad. Their delicate and delicious flavor and their exquisite bouquet are considered, by connoisseurs, to be beyond rivalry.

The level lands of the valley through which the line of railroad passes, and the beautiful sunny hillsides on either hand, are covered, apparently, by one immense vineyard. This whole district, with an area of 250,000 acres, is devoted to wine culture, and the annual production has an estimated value of fifty or sixty millions of francs—ten or twelve millions of dollars.

We dined at Dijon, the name of which town is familiar to all as one of the places which obtained some celebrity during the late war. Here we met a veteran who had been partially disabled in a skirmish with the Prussians in 1871, and a bright young French student with whom we enjoyed a pleasant and instructive conversation until our change to the branch line leading to

LE CREUSOT.

Long before reaching the latter city, we could see, away across the country, great masses of smoke rising slowly from the valley and floating across the hills, like heavy thunder clouds, obscuring large tracts of the country which was elsewhere beautifully illuminated by the bright light of the moon, then just past the full. As we finally skirted the town and rushed toward the station, a sight burst into view such as we had never before witnessed, and to which no verbal description can do justice. The vast clouds of smoke which we had been watching, miles away, were issuing from the tops of myriads of chimneys and from the midst of numbers of great blast furnaces, which rose, like so many towers of Babel, far above the surrounding building. The long structures, covering the rolling mills and the forges, were plainly seen through the gloom, lighted up by a ruddy glow from great masses of hot metal passing through the rolls, or by the brighter glare of scores of forge fires; and on the hill above and behind the works, barely revealed by the light of the partly obscured moon, we could see the populous town which has grown up here, founded and supported by this marvelous example of recent industrial progress. A dull intermitted roar of escaping steam, the loud clatter of gearing from the rolling mills, and the rumble of the rolls, with the unceasing concussions of many steam hammers, the sound of loud voices now and then rising above the noise of machinery, and the barking of the numerous dogs in the city beyond, mingled and produced almost as novel and exciting an impression upon the ear as did the strange and interesting scene upon the eye.

A frugal and truly French repast of bread and delicious native wine was furnished at the humble inn at which we stopped for the night; and we retired early, sleeping soundly in beds as clean and comfortable as we ever found at an English country tavern, or in our own New England. Before we had finished our breakfast, our kind friend, the proprietor of this wonderful establishment, who had already been informed of our arrival, called to take us in charge, and we spent the day in its exploration.

A century ago, this busy valley was a deserted and sparsely inhabited spot, forming part of one of the least productive estates in France. The discovery of its mineral wealth at that period was the commencement of its development, by the erection of an ironworks, in 1782, which was supplied with coal from the beds beneath it and with iron ore from the neighborhood. The machinery was driven by one of Watt's earliest engines, which is still preserved at Creusot as an interesting relic. The early prosperity of Creusot, then called Charbonnières, was seriously checked by the French revolution, and by the subsequent uncertainty in political matters; but, recovering, acquired such extent, when purchased in 1837 by MM. Schneider, that its value was fixed at 2,700,000 francs, and its production was stated at 40,000 tuns of coal and 6,000 tuns of iron. The number of workmen was not more than 1,200 to 1,500, and the population of Creusot was not much above 3,000. To-day we find 15,500 people employed in the mines and mills, two thirds of whom are engaged in the latter. The establishment produces 50,000 tuns of steel rails annually, and the new works, the construction of which is already begun, will, in a few months, largely increase this figure. Of iron rails, 20,000 tuns are turned out this year. A hundred locomotives and an immense quantity of other machinery are also included in the annual out-put of Creusot.

There are twelve blast furnaces making ordinary and Bessemer pig metal. The later furnaces are 20 meters—65 feet—high, while some of the older ones are 25 meters. The maximum efficiency seems to have been found at an altitude which has been found best also in some portions of our own country.

The Whitwell and the Cowper hot blast stoves have both been used here, and the new furnaces have a stove which M. Schneider calls a hybrid "Whitwell Cowper." The temperature of blast is carried at about 600° Centigrade=1,080° Fah. The fuel is coke, from native coal raised on the premises or at St. Etienne, where are mines which have the same ownership. The ores of the neighborhood make very good iron, but, for the Bessemer process, iron is made from ores imported from Africa. These ores are as pure and rich as the English Cumberland, and our best Missouri or Lake Superior ores.

Here we saw, for the first time, the molten iron tapped from the blast furnace into ladles, which were drawn at once to the converters and the iron converted into steel without intermediate casting, cooling, and reheating. The economy thus effected is an important item in these days of close competition, and, in part, accounts for the success of these inland ironworks in competing with English makers of steel and in exporting the rails produced here to the United States. It is a matter of wonder that this coöperation of the furnace with the converter is not oftener met with, since there is no difficulty in making the arrangement, as a matter of engineering, and there must be many localities where the requisite capital may be obtained to take advantage of the natural facilities existing for such an economical combination.

The steel rails made here contain four tenths per cent of carbon, and are as strong and tough, and as resilient, as any made in Europe. They are of Bessemer metal. Where a softer steel is required, the Siemens-Martin process is adopted. I think that it was at Le Creusot that this method was first made successful.

In the magnificent Creusot exhibit at Vienna were some fine samples of the product of this process, but we found the finest specimens here that we had ever seen. Such wonderfully ductile metal is precisely what is wanted to take the place of the weaker and less homogeneous metal, iron, for thousands of purposes. These samples were said to contain one fourth of one per cent carbon.

Eight new Siemens furnaces are in course of construction. The rolling mills are very large and are unusually well arranged. The buildings are neat and substantial and the machinery strong and well proportioned. The driving engines are not what we should, in the United States, consider the best possible design, but are well built and are strong and serviceable. The workshops contain much old machinery and some that is new and exceedingly creditable. The forge contains steam hammers of all sizes up to fifteen tuns weight of drop; and here, as well as in every other department, we saw evidence of good management and of intelligent supervision.

We visited the offices and drawing rooms, and found them well constructed, pleasant, and comfortable, with every possible facility for doing work and for communication with the various departments of the works. The telegraph is used very extensively for correspondence. Before leaving, we looked into the houses where the locomotives, used by the works for their own transportation, were kept. There are sixteen now in use, and they are not fully equal to the work. They are plain, powerful machines of the common continental type of freight engine, and exhibit no specially noticeable peculiarities.

The working people here seem to have a more efficient character and more industrious habits than is usual with French workmen, and impress the visitor very favorably by the contrast which they present to the sluggish, inactive, workmen generally seen in Europe.

After a very thorough examination of this greatest of all the French ironworks, after enjoying the generous hospitality of our host, and after a stroll about his pleasant grounds, we took the evening train for

LYONS.

We have not space in which to describe this fine city, or to give even the merest abstract of the memoranda gathered here in the great center of the silk manufactures, where 70,000 looms, in 10,000 establishments, support 140,000 persons, and produce a value of $60,000,000 per year. The permanent Industrial Exhibition, which was visited with the expectation of learning much that would prove of interest, is a sad failure, although it opened so short a time ago under such encouraging auspices. We saw there some fine castings, in Siemens-Martin steel, from the "*Société Anonyme de Charente*," and a six inch armor plate from Marvel Frères, doubled up without crack, as stated, *cold*. Chevalier & Grénier exhibit a compound portable engine and boiler with removable tubes and firebox, as at Vienna. The engine governor was of the parabolic class, and the whole was a good piece of work. The immense buildings look barnlike and empty, and we came away disappointed.

Before taking the train back to Paris, we visited the observatory on the hights of Fourvières, and spent an hour or more enjoying a splendid panorama embracing many miles of the valleys of the Rhone and the Saône, which have their confluence at Lyons, and, a hundred miles away, over the eastern hills, taking in the hazy outlines of Mont Blanc. Then, after an uneventful all night ride, we were back in Paris, ready to leave the continent and to spend a few days in Great Britain. R. H. T.

THE ATLANTIC CABLES.—The attempt of the Great Eastern steamer to lift and repair the Atlantic ocean cable of 1868 has failed, owing to stormy weather, and the great ship has returned to England. The work is postponed until next year. The fault has been located at a point not far eastward of the banks of Newfoundland. The cable was successfully grappled and lifted several times. A portion of the original cable, that of 1858, was brought up during the grappling operation and found to be in a fair state of preservation.

THE Preece block system of electric railway signaling is worked on the principle that the trains are to be kept a certain unvarying distance apart. No train can advance until the signal is given that the line for the specific distance ahead is absolutely clear.

THE passengers carried by the railways of Great Britian in 1872 reached the enormous total of 423,000,000. The total number carried in 1850 was only 78,854,422. The increases is mainly owing to the construction of underground and other suburban lines leading out of the large cities.