of fish, and some animals, chiefly belonging to the Eocene, Pliocene, or post-Pliocene ages.
Very careful analysis of a large number of the samples of land rocks taken from the pits above described, made in my laboratory, under my own supervision, gave, after being well dried at $21 i^{\circ} \mathrm{F}$., the following averages:

| Moistare, water of combination, and organic matter lost on ignition. . | 8.00 |
| :---: | :---: |
| Fhosphate of lime | $57 \% 8$ |
| Carbonata of lime. | $8 \cdot 88$ |
| Phosphate of iron and alumina | 60 |
| Carbonate of magnesia. | 0.78 |
| Salphuric acid and fluorine | . 80 |
| Sand, siliceous matters and undet | 10.6 |

These flgures suffice to show that the grade of this phosphate is not extremely high, but it is admirably adapted for the purpose of manufacturing commercial fertilizers, and will, therefore, long continue to maintain a leading position as a raw material in the markets of the world.
Before it can be made available for industrial purposes, it is made to pass through three distinct and successive operations: 1. Mining or excavating. 2. Washing it free from sand and other impurities. 3. Kilning, to free it from moisture. Taking these in their order, it is customary to establish a wain trunk railroad starting at the river front, or on the bank of some convenient stream, and passing right through the center of the property to be exploited.
Alternate laterals can be run off at right angles from any portion of this main line, at distances of say 500 feet, in conformity with the nature of the ground. Between and parallel to these laterals, a ditch or drain is dug to a depth extending 4 or 5 feet below the phosphate strata. From this main drain the excavators start their lines at right angles to the laterals, commencing at one end of the field and digging trenches 15 feet wide and 500 feet long, the work being so arranged that the men are stationed at intervals of 6 feet. Every man is supposed to dig out, daily, "a pit" 6 feet long, 15 feet wide, and down to the phosphate rock. The overlying material is thrown out to the left hand side of the trench. The phosphate itself is thrown out to the right, and taken in wheelbarrows to the railruad cars which pass at either end of the trench. The water drains from the trenches into the underlying ditch, and is then pumped out by means of a steam pump worked by a pumped out by means of a steam pump worked by a
secured to connected railway platforms, and run along the railroad track, from one ditch to another, as occasion requires. The cars, loaded with the crude phosphatic material dug out of the pits, are run down to the washing apparatus, constructed at an elevation of some 30 feet from the ground, and generally consisting of a series of sewicircular troughs 20 to 30 feet long, set in an iron framework at an incline of some 20 inches rise in their length.
Through every trough passes an octagonal ironcased shaft, provided with blades so arranged and ciistributed as to form a screw with a twist of one foot in six, which forces the washed material upward and projects the fragments against each other. The phosphate laden cars are hauled up an incline and their contents dumped into the bottom trough, where the phosphate encounters one or more heavy streams of water, run off at the bottom, but overflows at the higher end near where it enters. When sufficiently washed, the phosphate is pushed out upon a one-half inch mesh screen ; the small debris being received on oscillating wire tables below. It is now ready for kilning or dryng, and of all the methods hitherto adopted for this important process, that of simple burning or roasting, in an ordinary kiln, such as is generally used in the manufacture of bricks, has been found at once the ost rapid, effective and economical.
The rock is built on layers of pine wood, and owing o its containing a considerable quantity of organic matter, it readily lends itself to combustion and quires but a short time to become quite red hot
The kilns are made sufficiently large and so arranged as to allow free passage to a train of cars, which, running on the main line of railroad, can be loaded in the kiln, run down to the landing place, and discharged directly into the barges or boats on the river. With a properly constructed plant, regular drainage, and efficient management, the total cost of producing one to of South Carolina phosphate in clean, dry, raarket able co
lows :

| Mining, at a maximum dept |
| :---: |
| Draining the mine.................... |
|  |  |
|  |
| Drying and handing in kiln.........................shipping from kiln into vessels on river........... |
|  |  |
|  |
| Superintendence and management of mines. ........... <br> Towage to Charleston, say. |
|  |  |

The present selling price for dry phosphate, with an verage mean analysis of 57 per cent tribasic or bone phosphate of lime is $\$ 7$ per ton of $2,240 \mathrm{lb}$. on wharf at Charlestow.
As I have already said, the quantity of phosphate mined and sold in South Carolina during the past few years has been continually increasing until it has now reached the figure of about 500,000 tons per annum. Assuming that the unexploited deposits sti. cover an area of some thirty miles, and that they will yield the present average of 750 tons of phosphate to the acre, present average of 750 tons of phosphate to the acre,
we may count upon a reserve of about $14,000,000$ tons. With a constantly growing demand for "fertilizer" purposes, it would, therefore, seem as if the mining resources of the State would be exhausted in from fif teen to twenty years.
With a probable appreciation of these figures and acts, the efforts of the wealthiest mining companies now in the field are naturally directed toward the appropriation of all available and readily accessible deposits, and there is no doubt that while asquired on reasonable terms and worked with economy their exploitation will continue to be attended with very pro fitable results.

The dividends distributed during the past year by some of the companies, whose figures have been pub lished, amounted to a trifle less than $\$ 500,000$, and it is significant of the rapid intellectual growth and commercial and industrial development of the South that of the total phosphate mined in the State, more than one-fifth is actually used in Charleston for manufactur ing purposes. About one-third of the balance is ex ported to Great Britain and Germany, and the remain der is principally sent coastwise to Richmond, Baltimore, Philadelphia and New York.
When the great benefits accruing to South Carolina and its people from this industry are appreciated, it will not appear strange that active search for phos phate beds of similar value should have been stimulat ed in the adjoining States, and that the most intense not to say mad, excitement has manifested itself since the discovery some two years ago of the Florida phosphate deposits.
Note-The Florida phosphate beds will be fulls treated in the follow. (To be continued.)

The glaze upon enameled cards is made by pressure upon a polished plate or rollers. The composition is chalk, clay, and a little starch. Good work is not possible without elaborate accessories.

RECENTLY PATENTED INVENTIONS. Engineering.
System of Street Car Propul-sion.-Frederick G. Wheeler, Montclair, N. J. Com-
bined with the engine cylinders is a water chamber and a system of circulating pipes, with condensers arranged in the front lower part of the engine and connected with the exhaust ,orts of the cy inders, an auxiliary condenser being arranged on a higher level, while
pump connects the lower condensers and the wate chamber. The construction is such as to cause the water to circulate through a series of tubes back to the water chamber, while the water of condensation is led back to the water chamber, forming a complete circulating system. The invention is an improvenient on a former pateated invention of the same inventor in that
class of motors in which the water is heated in a stass of motors in which the water is heated in stationary boil

## Railvay Appliances.

Gondola Car.-Ferdinand E. Canda, New York City. This invention provides for the use of the car body, the ends of the rods beng provided with screw threads and nuts, the anchorage of the rods being made in the ends of the side buards and through iron castings forming anchor blocks, made in such form as
to be completely clamped and held in place by the side to be completely clamped and held in place by the side
boards, thereby being rendered secure against being boards, thereby being rendered secure against beirg
pulled out. This improved lateral support is wholly pulled out. This improved lateral support is wholly able space of the car is occupied by the ruds or fixtures.

## Electrical.

Battery. - Jacob O. Brinkerhoff, Hackensack, and Milten E. Smith, Rutherford, N. J. Combined with a copper cylinder forming one of the
electrodes is an exciting fluid formed of an antimonious chloride and in contact with the inner and outer surfaces of the cylinder. The inventors claim for this battery long life, high voltage, and no creeping or corroding. The exciting agent may be used in liquid or solid form and applied to one or both electrodes, in the common jar battery the electrodes extending into the
antimonious chloride, while in the porous cup batteries only one electrode is immersed.

Mechanical Appliances.
Barrel Hooping Machine. - Max Rosenow, Peoria, Ill. This invention provides attach-
ments for the ordinary iron hoop driving or trussing ments for the ordinary iron hoop driving or trussing
machine, whereby the machine can be readily adapted machine, whereby the machine can be readily adapted
for the driving of wooden hoops on barrels, providing also suitable means whereby the chine or head hoops can oe more effectually placed on the barrel without
danger of crushing or breaking them.

WOODen Hoop Loces.
WOODEN Hoop Locks. - The same
for cutting the locks in wooden hoops in a quick and the time they are cut, the machine also spreading the
positive manner. Combined with a revolving cutter butt of the shock prior to its dellivery from the positive manner. Combined with a revolving cutter butt of
head is a hoop-clamping device arranged at right angles
 pivotally supported and vertically adjustable in rela-
ion to the cutters. 'The hoops, after having one end ion to the cutters. The hoops, after having one end
cut into a lock, are held by their lock cut to the forked dges of lock, are held by their lock cat onds to the proper position for cutting.
Oil Cup. - Thomas McEntee, Jersey City, N. J. This is a lubricating device especially adapted for oiling the crank pin of a marine or other engine, or any moving portion of machinery requirin difficult to apply by the use of the ordinary cup or I has a needle valve for adjustment to give the re quired feed, and the cup is made of sufficient size to supply oil for twenty-four hours, or as long as may be desired, the quantity of oil in the cup being always indicated by a gauge tube.
Plumb and Level. - William J. Garner and Thomas Connaughton, Latourell Falls Oregon. This invention covers a combination devic having an extensible support that can be lengthened or shortened, combined with one or more spirit levels and stock and arranged transversely of and adjacent to the bob, while a suspension device is connected with the bob and extended upwardly, being secured at a spirit level and at the opposite edge is a swingin gravity level.
Watch Maker's Roller Remover. -Michael L. Sheehan, New York City. This is an im proved device for removing and replacing the rollers of watch balance wheel staffs or pivots, the inventio providing a simple construction whereby roilers may be in an expeditious and convenient manner, without disturbing the hair spring or injuring the pivote or ruby

Mechanical Movement. - Israel F. vertical allown, Pa. In a suitable frame is mounted above which is secured a post supported by radial bars, a gear wheel meshing with the lower pear wheel and connected to the post by a universal joint, with other novel features, the device bengg designed to furnish a
simpie means for multiplying speed and transmitting simple means for multiplying speed and transmitting

## Agricultural.

Corn Harvester. - Thomas B. rame Radnor, Ohio. Combinec with a gathering meane hinged to swing laterally, and having yielding
means for holding it normally parallel with the rows of corn, are upper and lower endless belts carried by the frame, and a stalk-cutting mechanism below the lower
belts for cutting the atalks as they pass betw oelts for cutting the stalks as they pass between the
belts. The stalks are held in an upright position at
clinton Lanker, St. Joseph, Mo. This invention con
sist of a plow having a double mould bourd and dis charging on to an incliued elevator provided with raking arms traveling over the grated bottom of the elevator to carry the potatoes upward, a discharge spout being arranged transversely below the elevator. The machine
gathers the potatoes, separates them from the soil and gathers the potatoes, separates them from the soil and other receptacles carried on the machine.

## Miscellaneous.

Bleaching. - Honore Korwin de Pawlowski, Paris, France. This invention provides an
apparatus for the bleaching of vegetable and animal matter, and the washing and scouring of wool and other substances, either woven or yarn or fiber, with the voidance of manipulation. Combined with a series of vats containing liquid, and conoected with each other
below the level of the liquid, are two vacuum receptacles, placed on a bigher level than the vats and connected with them below the level of the liquid, to effect alternately an automatic displacement of the liquid in the
Cane Juice Filtration. - Le o n Boyer, New Orleans, La. This is an improved ap-
paratus for treating cane juice by filtration, designed to make the juice so clean that the custom of using lime to neutralize the acid in the juice can be so simplified as to require but little skill or knowledge to carry it out. The invention provides a primary strainer box or tilter composed of a series of strainer drawers
arranged in sets one below the other, the drawers in arranged in sets one below the other, the drawers in
each set being of one mesh, but the several sets being each set being of one mesh, but the several sets bei
of successively finer mesh in a downward direction. Spraifing Device.-Williain J. Ruff, Quincy, Ill. This invention relates to a liquid cooling apparatus more especially designed for spraying beer device by small particles of hops and other substances lable to pass with the worts to the spraying apparatus. A valve is adapted to pass into the spraying orifice, being held on an adjustable valvestem, while a piston held on the valve stem is adapted to automatically actuate clogged.
Measuring and Drawing InstruMensuring and Drawing Instru-
aent.-Charles W. James, Philadelphia, Pa. Com-ment.-Charles W. James, Pailadelphia, Pa. Com-
bined with a forked arm are two arms of unequal bined with a forked arm are two arms of anequal
length pivoted between the members of the forked arm, the longer arm being of a length equal to that of the of the arms. The instrument is simple and durable in construction, and can be readily manipulated to obtain or measure inside or outside augles and obtann the miters of them, or it may be used for caliper-
ing, or arranged as a depth and end marking gaume

Speaking Tube and Eariphone. Frederick Schluchtner, Brooklyn, N. Y. This inven-
tion provides a speaking tube having, in addition to tion provides a speaking tube having, in addition to
the usual mouthpiece, a branch tube with an attached earpiece, the branch tube being located betiveen the Whistle and the mouthpiece. The whistle has an
operating handle exterior to the tube, and is closed by a spring on the handle.
Goods Exhibitor. - Noah E. Otto, Johustown, Pa. A strong, compact frame, easily
taken apart, carries a series of vertical rollers adapted taken apart, carries a series of vertical rollers adapted
to receive rolls of fabric, there being also combined with the frame a rack adapted to hold jrooms and similar shaped articles. The invention is designed to
provide a neat, compact and efficient receptacle for provide a neat, compact and efficient receptacle for other bulky and heavy fabrics, so that they may be well displayed and easily handled.
Savings Receptacle. -- Charles 0. Burns, New York City. This invention relates to fromes time to time and afterward deposting them in the bank. It provides a safety receptacle in which the box has a slot for entry of the coin, and an opening and closing lid, combined with a lock controlling the lid, a catch mechanism controlling the lock, and two
keys, one key being ftationary for operatung the catch keys, one key being atationary for operating the catch
controlling the lock, and the other a movable key to the lock itself, thereby affording increased security.
Scissors or Shears.-Julius Langenberg, Ohligs, Germany. Combined with the pivoted
blades is a spring-pressed pin protruding through one of the blades so as to impioge upon the other, whereby the two blades are pressed against each other automatically without using any hand pressure during cutting. The construction is also designed to insure the blades cutting the naterial during the whole cutting movement, from the point where the edges meet
toward the ends.
Bee Hive Tongs. - Crawford D. Holt, Murray, Ky. This is a novel form of tongs for handling the comb frames of bee hives, the tonys
having jaws adapted to clasp the tops and sides of the having jaws adapted to clasp the tops and sides of the
frames, with means for locking the jaws in position. These tongs aiford ready means of handlung the frames, avoiding the necessity of putting the hands or fingers in the hives and the atteudant danger of being stung by he bees.
Sash Fastener - Charles E. Angell, Salt Lake City, Utab. This is a combined window
sash lock and lift, consisting of a positive iocking bolt adapted to automatically engage with bolt holes in the window frame, an attached key for operating the
bolt, a pivoted thumb piece applied to the outer end of bolt, a pivoted thumb piece applied to the outer end of the key to operate the key and serve as a lifter, together
with an ad justable dog or catch adapted to engage with the key to prevent the latter from turning to act upon the locking bolt.
'Thill Coupling. - Augustos Beale,
coupling designed to be simple, durable and noiseless, whereby the pole may be conveniently connected to or helper. It also provides a means whereby the sufety straps may be readily conuected with or disengaged from_the pole or shaft.
Load Binder. - Harry M. Bradley, Canon City, Col. A longitudinally slotted bar with teeth on orposite sides has an aperture in one end or the attachment of a rope, the bar being passed pring-pressed pawls, and there being a rope attache o the lever, the whole forming a simple and conve ient device for binding loads apon vehicles in a quic and secure manner. The device may also be used for
Wagon Brake. - John W. Herrin which will be automatically applied to the front whee wich win be to which it is attached starts down on an moclined grade, and will be automatically released when level grade is reached or the vehicle is started up hill. The invention also provides a locking device whereb the brake may be locked either when applied or r

Watering 'Irough.-John 'T. Tha her, Frankfort, Ind. This trough has an aperture nd, with a valve arranged to slide past the aperture, in combiuation with a fioat hinged to the side of th rough and a rod connected with the valve at its lowe apper end. It is designed that the trough shall alway be filled to a deff nite level, the valve and fioat workin o effect this automatically.
Stove. - James W. Ca'_a, Castalia, South Dakota. This is a stove of simple and durable onstruction for heating and cooking purposes, and rubbish as fuel. All the heat generated is passed 0 arranged as to entirely avoid the puffing of th burning fuel.
Oil Can and Lamp Filler.-Charles W. Proctor, Lake Forest, IIl. This is a portable device ing a valved outlet at its lower end conected with elivery tube through which oil is suparied to a lamp without any waste and without the use of pumps. Th evice in simple and durable, and the oll flows by gravity from the can to the lamp.
Noтe.-Copies of any of the above patents will be urnished by Munn \& Co., for 25 cents each. Please of this paper.

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marked or labeled.
(3113) G. M. says: A question has come ap as to whether a piece of iron dropped into water of point where its density and that of the water would peint where its density and that of the water would Will you kindly anewer this and give explanation, also please state the greatest depth of any well or buring in the world? A. The iron will sink to the bottom of the deepest oceans. Every solid substance that is heavier
than water sinks to the bottom. The bottoms of the than water sinks to the bottom. The bottoms of the
deep oceans arecovered with gravel, sand and mud, with deep oceans are covered with gravel, sand and mud, with
shells and vegctable growth of the deep seas. Fish and other living organisms are found at great depths. The pressure of the water is in proportion to the depth. but its density is but very slighty increased, as water can be but very slightly compressed under great pressures. The deepest bored well is about 5,000 feet. (3114) A. C. R. asks: 1. Is lead a good electrical conductor? A. It has twelve times the resistance of copper. 2. Can you give me a recipe for
a good cheap silver polish? A. Use whiting and alcohol. 3. Have the effects of a kaleidoscope ever been shown on the wall like a magic lantern? If so, is the
apparatus difficult to make? A. The kaleidosope be thus used. It is described in Dolbear's "Art of Projection," $\$ 2$ by mail.
(3115) M. T. F. asks for the cheapest way of makinghydrogen gas. I wish to use it fora balloon in A. By treatment of iron or zinc scrap with dilute sulphuric acid. This is the usual way on a small scale, On the larger scale it may be made by passing steam
(3116) J. S. R. asks (1) as to the obelisk (in Central Park, New York), and also the Pyramids of
Egypt. Are they not generally considered (byscientific men) a composition, and not blocks of natural stone . What was the date of publication artifcial composition. of Scientific American? Was it a monthly paper, or or magazine, in its youth? A. September, 1845. It was weekly.
(3117) W. F. B. asks how bird lime is inseed oil until thick and viscid. There is much danger of confagration in conducting this operation. A bet ter way is to boil the middle bark of the holly for seven
or eight hours in water, and put in a beap in a hole in pathours in water, and put in a beap in a we is until reduced to a mucilaginous mars. It mut be rubbed up in a mortar avd washed until clean, and put
(3118) P. B. says A and B have an argumentahout the motion of a clock's pendulum. A says B is right. The pendulum must come to a dead stop
before it can change or reverse its movement. The
time required for the change is very short aud not me required for the change is very short and not

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INDEX OF INVENTIONS
For which Letters Patent of the United States were Granted June 16, 1891

## AND EACH BEARING THAT DATEE

[See note at end of list about copies of these patents.]

## Advertising device, H. G. Rich. Alarm. See Burglar alarm. Ammonia from








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Boring machines, adjustable stop for, W.P. K
logg. Eiectic resistance box Ietter box
Brake. See Car brake. Wagon brake.



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