

## MODERN SEARCHLIGHTS by frank c．perkins．

A new form of electric flashlight has been installed in the lighthouse tower at Heligoland by the Siemens－ Schuckertwerke，of Nuremberg，Germany．The search－ lights or projectors used at this installation are com－ bined，as shown in the views on another page． There are three lower searchlights，arranged 120 de－ greet apart，apd another mounted upon．the top，all operated automatically and driven by electric motors． The carbons，which are fed by automatic mechanism， are placed in a horizontal position，as is usual with most large searchlights．The intensity of the light is 30 million candle power as a minimum，and the maxi－ mum current used is 100 amperes．The light flashes occur every 5 seconds，and they remain in one position only ． 1 second．

The three searchlights mounted on the lower revolv－ ing platform 120 degrees apart have mirrors 29 inches in diameter and utilize a direct current of 34 amperes each，the platform revolving at the rate of four revo－ lutions per minute．The electrical apparatus was con－ structed by the Elektricitäts－Actiengesellschaft，for－ merly Schuckert \＆Co．，of Nuremberg．The current is supplied to the tower lights by a leadi iron－armored covered cable connected with the power station．The power plant consists of two steam engines directly con－ nected to dynamos of 216 amperes capacity at a pres－ sure of 75 volts．
This new electric beacon is to take the place of the old petroleum light that so long flashed out its danger signals at the mouth of the river Elbe．The new electric light is probably the most powerful at present in operation．Apart from its enormous power，the

Heligoland．lighthouse is noteworthy for the fact that a return has been made to the old form of parabolic mir－ or，with a powerful light in the focus，instead of the usual Fresnel lenses and prisms：
The mirrors of the Heligoland light consist each．of a piece of silvered glass．No protection against weather is provided in front of the light，and it is as serted that none is needed．Besides the three mir－ rors mentioned，a fourth mirror and lamp is pro－ vided，which will turn three times as rapidly，but which，it is said，will be used only in cases of emer－ gency．
The duration of one－tenth of a second for the flash，a characteristic of most French beacon lights，is here adopted for the first time in Germany．It is，however，a question whether these brief durations have not been （Continued on page 133．）


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The editor is almays glad io rece,ve for examiuation inustrated
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the new chemistry.
Just what shall be done with the newly-discovered radioactive substances is a problem that perplexes every thinking physicist. They refuse to fit into our established and harmonious chemical system; they even threaten to undermine the venerable atomic the ory, which we have accepted unquestioned for wellnigh a century. The profound mathematical deductions of the modern school of English physicists, based upon the startling phenomena presented by the Roentgen and Becquerel rays, as well as by the emanations of radium and polonium, may compel us to change our notions of ultimate units to such an extent that the old-time atom may be compelled to give place to something infinitely smaller. The elements, once conceived to be simple forms of primordial matter, are boldly proclaimed to be minute astronomical systems of whirling units of matter. This seems more like scientific moonshine than sober thought; and yet the new doctrines are accepted by Lodge, Crookes, and by Lord Kelvin himself.
The abandonment of the atom, at first faintly advocated, is now seriously discussed. When it is considered that radium, despite its prodigious radio-activity, loses an inappreciable amount of its mass-an amount calculated by Becquerel to be one gramme in a billion years per square centimeter of surface-the enormity of the atom and its utter inadequacy to ac count for the phenomena presented become manifest. Radium does emanate particles of some kind-this much at least is certain. These particles cannot be atoms; for atoms are so large that the active substance would rapidly lose in weight. The necessity of abandoning the atomic theory was long ago discussed. by Crookes. His study of the phenomena of the vacuum tube at high exhaustions had led him to formulate his "radiant matter" theory, for which he was compelled to bear not a little ridicule. To him it seemed that the luminous, electric, or mechanic phenomena of the vacuum tube could be accounted for only by assuming the existence of something much smaller than the atom-fragments of matter, $\cdot$ ultra-atomic corpuscles, minute things very much lighter than atoms, and indeed, the foundation stones of which atoms are themselves composed. Prof. J. J. Thomson, Sir Norman Lockyer, and Lord Kelvin later adopted some of his views. The discovery of the radio-active substances has placed the radiant matter theory on a firmer footing.
If we must discard the atom, what are we to accept in its place? Two new conceptions have been found necessary-the "ion" as the urit of matter, the "electron" as the unit of force. The new chemistry holds that matter and force are different manifestations of the same thing. Inertia is the characteristic, indeed the indispensable, property of both matter and electricity. What could be simpler than to assume that the ultimate particles of each are one and the same? Prof. Fleming has declared that "we can no more have anything which can be called electricity apart from corpuscles, than we can have momentum apart from matter." And Sir Oliver Lodge has given it as his opinion that the Dalton atom, which. was once an axiomatic conception of chemistry, may consist of a certain number of electrons rapidly moving in orbits.
Vague though many ideas of the modern chemist must necessarily be when his science is passing through an important transition stage, still he has calculated with no little nicety the masses of ions and electrons. Sir Oliver Lodge puts it thus: If we imagine an ordinary-sized church to be an atom of hydrogen, the electrons constituting it will be represented by about 700 grains of sand, each the size of an ordinary full stop, rotating, according to Lord Kelvin, with inconceivable velocity. Crookes puts it still more graphically. The sun's diameter is about one and a
half million kilometers, and that of the smallest planetoid about twenty-four kilometers. If an atom of hydrogen be magnified to the size of the sun, an electron will be about two-thirds the diameter of the planetoid. If the electrons of all elements are exactly alike, or in other words, if there is but one matter, just as there is but one force, and if the elements be but the various manifestations of that one matter, due to a different orbital arrangement of electrons, it would seem that we are fast returning to the conceptions of the middle-age alchemist. The transmutation of metals involves but the modification of the arrangement of electrons.

Many an old chemist looks askance at these modern views on matter. Few indeed venture to accept them without qualification. Of one thing at least we are certain-the atomic theory, if it is not a theory of the past, must be satisfactorily modified to account for the phenomena of radio-activity.

FIRE PERIL ON UNDERGROUND RAILROADS.
We have no wish to play the rôle of alarmist; but in the presence of the recent railroad tragedy in Paris, in which nearly a hundred people were smothered like rats in a hole, it is scarcely possible to exaggerate the risks which may attend the operation of electric-ally-driven cars in a subway or deep-tunnel road. While it is true that there were conditions peculiar to this French railroad that contributed to the swiftness and thoroughness of the disaster, conditions which are not present in our own New York subway, the fact still remains that the chief contributory cause is one that is inseparable from electrically-operated tunnel roads employing cars of wooden construction.
The immediate cause of the Paris disaster seems to have been the combination of poor insulation with cars of highly infiammable construction, for, judging from press reports, the latter seem to have been built of pitch pine, and to have embodied little, if any, really reliable fireproof construction. The burning cars were being pushed ahead by the following train, when by what seems to have been a piece of inconceivable mismanagement, two other loaded trains were permitted to run up close to the burning train ahead of them. In the height of the confusion the lighting system in the tunnel broke down, and the passengers found themselves enveloped in utter darkness and in an ever-increasing cloud of dense and suffocating smoke. The exits from the tunnel appear to have been very limited in capacity and the struggling mass of victims was unable to find even those that existed. Hence, it was only a question of a few brief minutes before the panicstricken mob succumbed to suffocation.

Judging from the comments of the public press and of the men who are responsible for the construction and operation of existing and proposed underground roads, both here and in Europe, the chief lessons of the disaster have been laid well to heart. It is recognized that. all underground tunnels should be provided with ample and easily-reached exits; that a complete system of ventilation must be installed; and lastly, and most important of all, that the cars must be of the very best fireproof construction. As regards the 20 miles of subway that are shortly to be opened in this city, the risk of suffocation due to the burning of a train are claimed to be not so great as on the Paris subway, for the alleged reasons that, generally speaking; the subway lies very close to the surface, the stations are closer together, and that the openings from the tunnel are ample for ventilation. As a matter of fact, the provision for ventilation throughout the greater part of the road is merely that which exists at the stations, where it consists of nothing more than the stairways for the entrance and exit of passengers. It is true that along the Boulevard there are open wells, but below 42d Street the subway will have to depend upon station stairways alone for ventilation. This is to be accounted for by the fact that the crowded condition of the streets renders it undesirable to provide openings through the street surface if they can be avoided, although we have always considered that it was a grave omission that special ventilating shafts were not put in at pegular intervals throughout the whole length of the road. Certain it is that if a fire should occur, say on Fourth Avenue or beneath 42d Street, the smoke and gases would have no ready means of escape from the tunnel, and dependence would have to be placed upon the movement of the trains to effect its discharge at the station openings. But when we consider that just as many trains will move in one direction as the other, it is difficult to see how the much-talked-of "piston effect" of the moving trains will clear the tunnel atmosphere by promoting a circulation of pure air.... Indeed it is pretty safe to say that it will do nothing of the kind, and in the event of a fire there will be nothing for it but to close the particular section of the tunnel where it occurs to all traffic until the fire is subdued and the smoke and gases have had time to dissipate.
Evidently, then, in our own subway it is more a question of prevention than of cure. That is to say, it is absolutely im-erative that the construction of
the rolling stock be such that the burning of a car or train of cars will be rendered impossible. The only certain way to insure this immunity from fire is to exclude from the cars every particle of inflammable material; and this can be accomplished satisfactorily only by building them entirely of metal.
We are well aware that the management of the Interborough Railroad Company have stated that the new cars are to be very thoroughly fireproofed, and it must be admitted that on paper the precautions that are to be taken in the way of incombustible linings for the fioors of the car, asbestos protection, the use of fire proof paint, etc., are among the most approved meth ods of protecting inflammable material. In the present case, however, the risks attendant upon the break-down of this system of fireproofing are so frightful that it should certainly be abandoned in favor of the only absolutely sure method of abolishing every particle of wood and making the cars, from trucks to ventilator, entirely of metal. We will admit that the system of insulation of the wiring and protection of the wooden fioor framing of the cars as outlined by the Interborough Company will probably prove to be effective against the blowing out of a fuse, or the other break-downs incidental to an electrical installation; but in the present case we have to provide against the extraordinary risks of fire, such as would occur in the smash-up of a collision. It can readily be seen that in a bad train wreck, whether by collision or derail ment, these elaborate fireproof precautions might lose all their value, and in the rupture of the wires and the short-circuiting and arcing that would probably occur, there would be not one, but many opportunities for a rapid confiagration of the wreckage.
Here lies the great and ever-present danger of wooden car construction (however well insulated its elec trical equipment may be) in a confined and crowded underground system such as is shortly to be opened in this city. Ours is to be no ordinary underground road. Its like has never been seen before. For where can we find a parallel to a road on which crowded express trains will be running under a headway of a few minutes at speeds of fully fifty miles an hour?
If the merchants of the city, who are agitating so volubly the question of a slight change of route over a single short section of the road, would devote their attention to this far more serious question of the safety of theoroad itself, their energies would be applied to better purpose. As we have said; we have no wish to play the rôle of alarmist, and we are satisfied that in drawing attention to this matter we are merely urging the city to take precautions. which, if they are not taken at the very outset, may ultimately result in a disaster second only in horror to that which has recently occurred in Paris.
Many of our readers will remember that it was not very long ago that George Westinghouse drew attention to this question of fire risk on tunnel roads, and advocated the very means of preventing it which we now urge. That the point was well made is proved by the fact that the most progressive railroad in this country, namely, the Pennsylvania, is already constructing experimental all-steel cars for use on its great tunnel system between New Jersey and Long Island. It is obviously the only thing to do, for, in the presence of this Paris horror, what was formerly expedient now becomes absolutely imperative.

## FOBEIGN GAS ENGINES AT THE WORLD'S FAIR.

The power plant of the forthcoming World's Fair St. Louis, will contain among other items a 3,000 horse power gas engine, the product of Societe Anonyme John Cockerill, Seraing, Belgium. This engine, we believe, will be the largest gas engine in service up to the time of its installation, and it is interesting to note that it will go to St. Louis wholly on an exhibit basis; that is to say, the Exposition is put to no expense for the power obtained other than the cost of transportation, installation, and maintenance. The World's Fair power plant will, we understand, embrace more than 40,000 horse power, and the installation will be wholly within the buildings comprising the machinery department of the exposition. For the most part, the prime movers of the power plant will be placed on either side of the main aisle running the full length down the center of Machinery Hall. This aisle will be about 1,000 feet in length. The en gines comprising the driving power of the exposition will include gas engines, turbine engines, and highspeed steam engines; but by far the most interesting feature of this power plant to Americans must be the gas engine display.
The 3,000 horse power gas engine, above referred to, has two cylinders, each having a diameter of 51 inches. The length of stroke is 55 inches and the revolutions per minute when. developing 3,000 horse power will be 85. The length over all of the engine is 67 feet 13-8 inches. The bed-plate or foundation proper will have a length of 77 feet, 6 inches. The foreign exhibits for the St. Louis power plant were gathered by Lieut. ment of the exposition, who was detailed by the SeO
retary of the Treasury for service at St. Louis. He has been engaged for nearly nine months in Europe in collecting late-type units for the machinery depart ment, and more power, we learn, was turned in by foreign manufacturers than could be used at St. Louis.

While the John Cockerill. Gas Engine will reprèsent the largest gas engine in service up to the spring of 1904, Lieut. Carden informs us that when he was. at the works of the Gasmotorenfabrik-Deutz, Deutz near Cologne, Germany, he found that that establishment was engaged in completing designs for a 6,000 -horse power gas engine, and that the statement was made to him that by 1905 gas engines of this unprecedented size would be put on the market. When one considers the relatively small units in which gas engines are built in America, the advanced stage of the gas engine industry in Europe must be at once apparent. In addition to the John Cockerill engine there was secured a 1,600 -horse power gas engine of the Oechelhauser type, the product of the house of A. Borsig, of Tegel, type, the product of the house of A. Borsig, of Tegel,
near Berlin. The Borsig engine will be attached to a Crocker-Wheeler electric generator, and the gas producer will come from the German house of Julius Pintsch, of Berlin. The Pintsch gas producer will have a capacity sufficient for developing 2,400 engine horse power. The total weight of the shipment from Tegel will approximate 660 tons.

A 1,800-horse power gas engine of the Nuremberg type will also be put in service at St. Louis. The drawings of this engine show a length over all of 60 feet and a breadth between extremes of 19 feet 4 inches. The flywheel will measure 18 feet, and at 1,800 horse power the number of revolutions will be 92 per minute. Large as this flywheel is, it will be exceeded by that of the John Cockerill engine, which will be 26 feet 3 inches in diameter.
Aside from the gas engines displayed at St. Louis the exhibit of high-speed steam engines is bound to attract great interest, for it must be admitted that in the matter of high-speed engines of large powers, we have not made so much progress as foreign manufacturers. The house of Delaunay-Belleville, of Saint Denis (sur Seine), France, will send to St. Louis a complete unit of 1,500 horse power, embracing a highspeed vertical triple-expansion engine, with boilers and generator complete. This engine will operate ordinarily at 325 revolutions per minute. Another high-speed engine is a $\mathbf{1 , 2 0 0}$-horse power unit of the Williams \& Robinson, Rugby, England, type.- Among the famous foreign engine builders who have made offerings for the St. Louis power plant are Franco Tosi, of Legnano, Italy, a 2,500 -horse power steam engine; Carels Frères, Ghent, Belgium, a 2,500 -horse power steam engine; Augsburg-Nuremburg, Nuremburg, Germany, a 2,500horse power, vertical triple-expansion engine; Greenwood \& Batley, Leeds, England, a 300 -horse power wood \& Batley, Leeds, England, a
turbine engine; Société Alsatienne de Constructions Mécaniques, Milhausen, Germany, a 1,000 horse power tandem engine with direct-connected dynamo.
The Machinery Hall of the St. Louis Exposition is already applied for several times over, and with the great power plant, aggregating 40,000 horse power, installed in the center of this building, there is every reason to believe that the machinery display at $S$. Louis will exceed in completeness, extent and in the up-to-date features presented, anything of the kind in the way of a machinery exhibit the world has ever seen.

## THE MANDATORY BLUE PRINT.

From some experiences of my own and cases where I have been called in, I am led to believe that departures from the absolute readings of blue prints are quite common. That is to say, persons who undertake to construct machines or apparatus of all kinds from them permit themselves to act as judges as to whether the proportions laid down are correct or not, and whether other forms than those shown would not be whether other forms than those shown would not be
better. If the designer of the machine were consulted previously concerning the proposed changes there would be no harm done, for he would have an opportunity to decide whether the so-called improvements were such in fact, or only mere impertinences upon the part of those who suggested them. In one case an inventor had designed a machine which had a peculiarly appropriate movement which he had covered in his patent claim; when he examined his machine he found that this had been disapproved of by some one connected with the works, and a monstrosity of their own devising inserted in fits place. As a consequence, he rejected the machind, and demanded that his device be put in its place; the constructors rehis device be put in its place; the constructors re-
fused to do this, for the machine would have to be practically rebuilt to get it in, and suit was brought to recover, the result being that the builders had to pay heavy damages and costs.
It is important that all persons accepting blue prints as guides to work from should bear in mind that they have no responsibility whatever if they reproduce line for line and flgure for figure, and adhere closely to the dimensions; failing this, they assume all the liabilities
of the slightest omission or change, no matter whether the same is an improvement or the reverse. Under Ome interpretation of shop ethics, it is supposed to be a "neighborly" proceeding to make changes and alterations without consultation. After an exhibition of such "neighborliness" a constructor recently said to his customer: "Your machine is all right now; we had to go all over it, for it wouldn't have worked the way you had it"; and great were his surprise and chagrin on learning that several machines were already at work upon the identical plans he had condemned as impracticable. As in the previous case mentioned, the contracting party refused to accept the job.
It has been decided by the courts that the acceptance of a blue print from contracting parties is in itself a guarantee that the machine constructed. from it shall be an exact duplicate in metal or other material, and no explanations as to failure to follow the print will absolve the contractor from neglect to perform his part of the agreement. In plain words, a blue print is mandatory.
Within a very short time I have been asked to compare the work upon a certain boiler with the blue prints furnished by the contracting parties. The departures from it found were many, the curibus part of the execution of the work being that the changes made were of no pecuniary benefit to the boiler makers. In one case a pipe was inserted which was one inch diameter only, the drawing calling for one and a quarter inches; the contractor decided that this last was too large, and made the change without consulting the owners. Consultation is always necessary in constructing work where changes that are imperative have been overlooked by the designer, for the most expert men are not infallible. Clerical errors, also, are not unknown, where different dimensions are put on detail sheets for the same members. When a difficulty of this class is encountered, the duty of a contractor is to ascertain which is the right one before proceeding with the work. A word as to the procedure with blue prints may not be amiss. How many are there who sit down to inspect them carefully-peruse them is a better word-before handing them to a subordinate to execute? The number of such persons is fewer than might be supposed. A common practice is to send them directly to the shops, but before this is done the chief draftsman should have his will of them, where no one can molest or make him afraid; for, be it known, the average blue print is far from perfect in its entirety. Scale drawings are a necessity to give an adequate idea of the finished machine, and the relations of parts one to another, but no man can work from an unmarked scale drawing, because the truth is not in it. The great printer, the sun, has looked askance at it, and the measurements, or the scale sizes, are distorted amazingly. There is no size on it which can be trusted to measure from and reproduce in metal; the draftsman who made it is human and prone to err. Nothing but the absolute figures is reliable, and of these there is an alarming scarcity in some drawings. For these and for other considerations, before construction is commenced, all blue prints should be carefully studied by an expert.

## N-RAYS DISCOVERED BY M. BLONDLOT.

In a recent issue an account has been given of the new form of radiation discovered by M. Blondlot: He finds, in fact, that most of the artificial sources of light and heat emit radiations which are capable of traversing metals and a great number of bodies which are opaque for the ordinary rays of the spectrum. In a paper read before the Académie des Sciences he describes some later researches upon this new form of radiation. The rays were flrst discovered by using a Welsbach burner, but he wished to see whether they are given off from other sources. A circular gas flame emits them, but the chimney must be removed on account of the absorption of the glass. A Bunsen burner does not appreciably produce them, but a piece of sheet iron or a silver plate heated with a Bunsen burner behind it will give off the rays almost as well as a Welsbach burner. A plate of polished silver inclined at 45 degrees and heated to a cherry red by a Bunsen burner was found to emit rays which are quite analogous to the former. A horizontal beam of this radiation, after passing through two sheets of aluminium or a total of .01 inch, as well as black paper, etc., was concentrated by a quartz lens. By using a small electric spark as an explorer, as before, the existence of four focal regions is shown. He also finds that the action on the spark is much greater when it is placed vertically or in the plane of the emission, than when it is perpendicular to this plane. This shows that the rays coming from the plate are polarized, as are those of the light and heat which it emits at the same time. When the plate is covered with lampblack the intensity of emission is increased, but now the polarization disappears. M. Blondlot uses the term N-rays* to designate the new radiation. He remarks that they in-
*From the Uuiversity of Nancy, where most of the experiments were made.
clude a great variety of radiations; in some cases the index of refraction is greater than 2 and from other sources it is below 1.5. Up to the present a spark is used as a detector, but if considered only as incandescent gas, the spark should be replaced by a flame. He used a small flame formed at the end of a metal tube with a fine bore. This flame, which is entirely blue, can be used instead of the spark, and, like it, when it receives the rays becomes whiter and more luminous. By the variations in brightness he finds four foci in the beam traversing a quartz lens, the same as with the spark. He also finds a new effect of the N-rays. They are incapable of exciting phosphorescence in bodies which acquire it by the action of light, but when such a body, for instance sulphide of calcium, has been previously exposed to the sun and rendered phosphorescent, if now it is exposed to the N-rays (especially at the focus through a quartz lens) the phosphorescence is seen to increase in brightness considerably. This phenomenon is one of the easiest to observe in the case of the N-rays. This property is analogous to that of red or infra-red rays as noted by M. Becquerel and also analogous to the action of heat on phosphorus. It seems certain that the new rays have points in common with the known rays of great wave length. On the other hand, the property which they have of traversing metals differentiates them from all others known. It is very probable that they are to be found among the fine octaves of the series of radiations which remain unexplored between the Rubens rays and the shortest electro-magnetic waves, and this he proposes to verify.
In another series of researches he finds that the rew rays are given off by the sun. A chamber which is completely closed and dark has a window exposed to the sun, and closed by thick interior shutters of $5 / 8$-inch oak wood. Behind one of the panels at 3 feet distance is placed a tube of thin glass containing phosphorescent sulphide of calcium which has already been slightly exposed to the sun. If in the path of the rays from the sun which are supposed to reach the tube through the wood, a lead plate or simply the hand be interposed, even at a great distance from the tube, the brightness of the phosphorescence is seen to diminish. When the screen is removed the brightness is restored. The great simplicity of the experiment makes it easy to repeat; the only precaution to take is to operate with a low initial degree of phosphorescence. The variations of brightness are especially easy to observe at the contours of the luminous spot which is formed by the phosphorescent body against a dark background. When the N -rays are cut off these contours lose their sharpness, but resume it when the screen is removed. These variations do not seem to be instantaneous, however. The phenomenon still takes place when several plates of aluminium, cardboard, or an oak plank 1 inch thick are placed in the path of the rays. All possibility of the action of radiant heat properly so-called is therefore excluded. A thin layer of water is found to stop the rays entirely, and even light clouds passing over the sun diminish the action considerably. The $N$-rays which are given off by the sun can be concentrated by a quartz lens, and with the phosphorescent body as a detector he observes the existence of several foci, but expects later on to determine their position more accurately. The rays undergo a regular reflection from a plate of polished glass, and are diffused by ground glass. In the same way as the N -rays which are given off by a Crookes tube, flame, or incandescent body, those given off by the sun act on the small spark or flame and increase its brightness.

## LANGLEY'S AERODROME EXPERIMENTS.

Prof. Langley's 12 -foot aerodrome was tested on August 8, with results considered decidedly encourag ing by its inventor. The model flew a distance of 600 yards and then sank in 22 feet of water. When it was finally recovered, all that was left was a tangled wreck of twisted wires. The time consumed in flight was not more than 45 seconds. The course described was a semi-circle. According to accounts which have been published, the motor of the machine and the rudders failed to work properly. The altitude of the machine at the time of the fall was not greater than 50 feet. From the meager reports which are thus far available, it seems that the airship was driven by an 8 horse power hydrocarbon engine connected up with two twobladed propellers located one on each side of the machine at about its middle point. One four-bladed wind vane rudder was mounted behind the engine; then came the rudder proper. On each side the airship was supported by a pair of white silk wings, $41 / 2$ feet long by 2 feet in width. The propellers were located on the side between the wings and turned toward each other. The wings, rudders, engine and other running gear were fastened to a central cylindrical tube of aluminium 18 inches in length and about 4 inches in diameter and tapering at both ends. It is said that the test of the small model will be followed at an early date by a trial by the 60 -foot aerodrome which is owned by the government, and which cost $\$ 70,000$.

## THE HODSON RIVER TUNNEL

The work of driving the Hudson River tunnel from Jersey City to Manhattan has progressed so favorably under its present management, that before very long communication beneath the river will be established. The tunnel will provide communication between the trolley systems of New York and Jersey City, and by affording a rapid and continuous ser vice between these cities, will confer a great boon upon the traveling public who hitherto have been re stricted to an intermitten ferry service. The origin al projector of the Hudson River tunnel was Mr. Dewitt Clinton Haskin, one of the active spirits in the building of the Union Pacific Raiìway, who com menced the construc tion of the tunnel as far back as 1874. The origin al plan called for two separate tunnels with a single steam railroad track laid in each. A circular work ing shaft 30 feet in dia meter was dug on Fif teenth Street, Jersey City, 100 feet inside the bulkhead line of the river; it termina ied in an enlarged chamber from which the headings of the two paral lel tunnels were started on an easy grade toward their deepest level, which lies in the proximity of the Manhattan shore. The New York shaft was sunk near the bulkhead line at the foot of Morton Street, the distance between the two shafts being about 5,400 feet. Mr. Haskin commenced the construction of the tunnel without the use of the customary excavating shield and iron lining, relying upon the compactness of the silt through which the tunnel was driven to prove sufficient, in co-operation with the compressed air, to resist distortion until the 2-foot brick lining of the tunnel could be built in place.

The difficulty of closing air leaks with sufficient alacrity led to the use of a pilot tunnel at the heading. This consisted of a 5 -foot iron tube which was carried forward on the line of the axis of the tunnel into the ground ahead. This tube was used as a center from which braces were carried out radially to hold the surrounding wall of the tunnel during con-
purpose of completing the tunnel; but after carrying the tunnel forward until 3,895 feet was completed, they also abandoned the work. Ultimately the New York and New Jersey Railway Company was incorporated for the purpose of carrying through the great undertaking, and they have prosecuted it with such vigor that the north tunnel will probably be completed in January, 1904.

The tunnel descends


View in Rear of Shield at Heading, Showing Full Diameter of Tunnel (19 Feet 4 Inches). from the Jersey side on a grade of about two per cent, and at a depth below the river bottom which varies from 5 feet to over 60 feet. The shaft already referred to at the western end of the tunnel is 30 feet in diameter and 65 feet in depth. It is brick-lined and opens into the power house in which the new operating plant has been installed. The external diameter of the northern tunnel is 19 feet $51 / 4$ inches and its internal diameter 18 feet $11 / 4$ inches. The southern tunnel, which is being built of a diameter to accommodate the trolley cars which it is now intended to run through the tunnels, is 15 feet 3 inches in internal diameter, and 16 feet 7 inches in external diameter.

Both tunnels are being built by the Great
struction. On July 21, 1880, a shocking accident occured, due to the shallowness of the overlying silt above the tunnel roof. There was a blow-out which resulted in such a sudden in-rush of water that the air lock became jammed, and twenty of the workmen were caught and perished. The work was carried on with more or less intermission until, with 2,000 feet of the north tunnel completed, the company in 1882 suspended operations. Subsequently, in 1890, an Eng. lish company was formed with Sir John Fowler and lish company was formed with Sir John Fowler and
Sir Benjamin Baker as consulting engineers, for the
head shield system and lined with a castiron shel which is made in $\cdot$ segments provided with internal flanges by which the shell is bolted in place. It is interesting here to recall the fact that the first use of the system of tunneling now known as the Greathead system ever made in this country occurred in the construction of a short section of the projected Broadway underground railway in this city, when the method designed by the late Alfred E. Beach, one of the editors and proprietors of this journal, was successrully used.


View of Twin Air-lock in Tunnel, Showing Shifting Rails for Entering Lock Chamber.


Front View of New Shield for South Tunnel.


Profile of the Hudson River Tunnel, Showing by Black Shading the Portions Yet to be Excavated.

## THE HODSON RIVER TUNNEL.

After the English company abandoned the construction of the northern tunnel in 1891, it was allowed to fill with water. When the work was taken in hand by the present company the tunnel was pumped out, and it was found that with the exception of some 470 feet, the work already done was in good condition. This was in the latter part of 1896, and from that time until 1902, when orders were given to proceed with construction, the tunnel was regularly pumped out and maintained in good condition. A new building was erected at the Jersey shaft, equipped with a very complete power plant, including hydraulic pumps and air compressors, etc. The shield which was used by the English company was overhzuled and is being used in completing the north tunnel. It was designed for use only in silt, and as the tunnel has now reached a point where rock and boulders are encountered in the lower half of the excavation, it has been found necessary to build a heavy apron, extending 6 feet in advance of the upper half of the cutting edge of the shield, and reaching from side to side of the shield. This apron is built of 12 -inch I-beams and $3 / 4$-inch steel plates, and it is strongly braced. Under the shelter of this apron, which is heavily shored up, the workmen are able to pass forward of the shield and drill and blast out the rock below it. This work is unique in horizontal shield excavation, and so far
it has been carried forward with complete success. The method of operating the hydraulic shield is so well known as to need no detailed description here. It is forced forward into the silt by means of hydrau lic rams which are set up between the front edge of the completed iron lining of the tunnel and the rear edge of the shield. As it moves forward, the silt is squeezed through open inlets into the interior of the shield, where it is broken off, loaded into trucks, and drawn away from the heading by a cable. The finished tunnel is divided into three lengths by two air locks, one of which is shown in our accompanying engraving. It should be explained that the lower ha'lf of the tunnel, at the point where our picture is taken, was filled with excavated material from the heading, on which the two tracks are laid. Ultimately this material will be taken out and the full diameter of the tunnel exposed. In our engraving the two trolley tracks are clearly shown, together with the doors by which the cars pass through the air-tight diaphragm. Another of our engravings was made from a photograph taken in the rear of the shield at the present heading. In this case the material has been entirely removed, showing the full diameter. The two tracks shown are merely narrow-gage working tracks for the contractors. Ultimately, of course, a single track will be laid for

sectional view of heligoland lighthouse projectors.
the operation of trolley cars. The cable-hauling system is built in three sections, separated by the two airlocks. The first of these, which is 1,575 feet in length, extends from the Jersey shaft to the first air-lock; the second, 1,660 feet long, extends from the first to the second air-lock, while the third section reaches from the second air-lock to the working face. The cables are driven at a speed of 300 feet a minute and are capable of handling 300 tons of excavated material
through a train of gears, and the other starts or stops the electric motor which controls the horizontal movement of the beam of light. The Iris shutter is used in order to make the projector perfectly light tight at any moment desired, and it operates similarly to this type of shutter as applied to modern cameras. The leaves of the Iris diaphragm slide within a fixed diaphragm located in the axis of the ray of light and provided with a fold. On some of the German searchlights an apparatus known as a "double disperser" is provided, in order to convert concentrated light rapidly into diffused light. This arrangement consists of two parallel systems of cylin drical lenses, which may be slid against one another, whereby the angle of dispersion of the emitted ray can be varied at will. By means of this apparatus the angle of dispersion of the light can be varied within limits of from 2 degrees to 45 degrees if desired.

THE BEAVER AS A DAM-BUILDER.
A remarkable beaver dam has lately been discovered near Stroudsburg, Pa. The work of the animals is so extensive that it seems almost incredible they could have built the dam in question, but this is proved by the evidence of residents of the vicinity, who are strictly reliable.
The dam in question was dis covered about two years ago, by

## TRUNKS AND LIMBS OF TREES GNAWED BY BEAVERS

in every ten hours. One of our engravings represents a profile taken across the North River in the plan of the north tunnel. The completed portion of the tunnel is shown by light shading, while the darker shading shows the amount, about 800 feet, that has yet to be excavated.
On the south tunnel new air-locks have been installed, the necessary machinery is being built, and it is probable that the actual construction of the tunnel will be taken up again in the fall of the present year. The shield for this work, which was designed by Jacobs \& Davies, engineers of the company, is shown in the accompanying engraving. It will be seen that it is divided by one horizontal and two vertical frames and by transverse diaphragms. The shell is double and the whole construction is calculated to give great stiffness and resistance to distortion. It is provided in front with a movable working platform which, if necessary, may be carried forward of the cutting edge. In the rear it is provided with the necessary hydraulic jacks, valves, etc., for carrying forward the shield and for swinging the erector-a massive arm which moves something like the hands of a clock, and is used for picking up the cast-iron plates and placing them in position ready for bolting up. It is interesting to know that in spite of the difficult nature of the material through which the tunnel is now being driven, there being rock below and soft silt in the upper half of the tunnel, progress is being made at the rate of between 4 and 5 feet a day. The work is rendered particularly hazardous by the fact that there is a hydraulic head due to 65 feet of water, and that there is only 10 feet of soft silt between this hydraulic pressure and the roof of the tunnel. The successful financing of the company was completed through the efforts of Mr. William G. McAdoo, the president, associated with a few trolley capitalists, and to him we are indebted for the facts given.

## MODERN SEARCHLIGHTS

by frank c. perins.
(Continued from first page.)
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 at Büsum, a distance of 40 miles, which in itself seems sufficient to clear away all doubts of the visibility of a fiash of short duration.
The front-page illustration shows a Schuckert searchlight with an Iris shutter, half closed, which has a diameter of 6 feet 6 inches and throws a beam of light of 316 million candle power. This search light is electrically controlled by two levers, one of which controls the motor mounted in the base of the searchlight which operates the projector in a vertical direction
a farmer living near its site. It is located in a swamp, which for many years had been drained of its surface water, except in a few spots. Noting that most of the swamp was under water, although but little rainfall had occurred, the curiosity of the farmer was aroused, and he made an investigation which led to the discovery. The dam has been constructed around the northern edge of the swamp, extending in a zigzag course, evidently to avoid obstruction, and to increase its strength. it is about 125 feet in length, and the top is wide enough for a man to walk upon, without difficulty, ranging from a foot to two feet in width. At present the top is about three inches above the surface of the pond which has been created by the dam, the water being from two to four feet deep.

The farmer who made the discovery at first thought that the work had been done by boys for sport, but noticing the footprints of animals upon the top of the structure, he followed these, and found some piece of wood, which apparently bore the marks of an animal's teeth. The wood was taken to a naturalist who resided in the vicinity, and after careful examination the latter pronounced the marks to be from beaver


PROJECTORS OF TAE RELIGOLAND LIGHTHOURE.
teeth. Further investigation in the vicinity showed that the animals had felled a number of trees near the dam, to use in its construction. The largest pieces yet found in it are 8 inches in diameter by actual measurement. The principal material used, besides branches and twigs, was mud, which had been deftly worked into it so solidly that a man weighing 235 pounds has walked upon the top without affecting it.

The wood which has been used includes beech, white ash, and oak. In cutting the trees, the animals work ed in a circle around the trunk, making deeper inden tations on the side toward the dam so that the trees would fall into the water in the proper direction Judging by the size of the marks found, it is believed that some of the beavers are unusually large animals, but there have been only two or three seen since the dam was constructed. The discovery has aroused such interest that many naturalists have since visited the locality. Their belief is that the swamp has been "beaver ground" for many years, and that here has existed one of the very few colonies of these animal in the northern part of the country. The swamp is wned by Judge Edinger, of Stroudsburg, who has been making a study of the dam since it was located. So interested has he become that he will allow no one o attempt to trap or shoot the animals, and, with the aid of the Zoological Society of Philadelphia, has had a State law enacted purposely to protect them.

## That Point Reyes wind Record.

For the last two or three months, accounts have been going the round both of the daily and the tech nical press, in which it is stated that at Point Reyes, about 35 miles north of San Francisco, the wind re cently blew continuousiy for three days at a rate considerably over 100 miles an hour, and that speeds up to 135 miles have been recorded. It is also asserted hat for two years the Point Reyes station has taken the world's record for speed of winds
The Scientific American has taken the trouble to investigate these statements and is informed by the Weather Bureau that there are no records of "wind velocity of 135 miles having been attained at Point Reyes," From the establishment of the. station at Point Reyes Light on March 1, 1889, to the end of May, 1903, the following are the maximum velocitie recorded during the several months.
January
75 July
March
108 August
April
8 Septembe


20 Novembe
80 Decembe
June
uring May, 1903, a very severe storm raged a Point Reyes for a number of days, and for nine con secutive days the wind Dlew at an average of 52 miles per hour.
Even if 135 miles an hour had been attained by the wind, at this point, still that velocity would not have broken all records in this country. We are assured by the Weather Bureau that one of its stations was in operation at Mount Washington, N. H., from June, 1871, to September, 1887, and that for three months, July, August, and September, the following maximum velocities were recorded:
January .............. 18.6 July ..................... 120
February .............. 168 August .................... 120
March .............. 156 September......... .116


May ................... 128 December .:............ 180
Compared with these high velocities the Point Reyes records pale into insignificance.

## Death of Dr. Ludwig Mond.

Dr. Ludwig Mond, the well-known chemist, died re cently in Rome. Born in Cassell, Germany, in 1839 , he was educated at Marburg and Heidelberg. He emigrated to England in 1862, and there introduced his well-known process for recovering sulphur in alkali works. Eleven years later he established the largest alkali works in the world at Winnington, England. He was the inventor of a process for the manufacture of chlorine and of a method of producing gas for heating and power purposes. In last week's Supple Ment will be found a good description of Mond gas and its manufacture. Dr. Mond also invented a ga battery and a process of making pure nickel. The latter was based on the formation of what he called nickel carbonyl, a chemical compound which he discovered and investigated with Langer and Quincke The Davis-Faraday research laboratory, now famous throughout the scientific world, was founded by him in 1896. Besides being a scientist of rare parts, Dr Mond was an art lover, whose collection of early Italian masters is one of the finest in England

The heaviest train load ever hauled by one locomoThe heaviest train load ever hauled by one locomo-
ive was recently reported. A train of eighty-four oaded cars, weighing in the aggregate $4,787.5$ tons was hauled a distance of 63 miles, at the rate of 13 miles an hour.

## Electrical Notes.

The production of aluminium is given in a report on aluminium and bauxite for 1902, by Dr. Joseph Struthers, issued by the United States Geological Survey. The production of aluminium in the United States during 1902 was approximately $7,300,000$ pounds, as compared with $7,150,000$ pounds in 1901, the sole produce being the Pittsburg Reduction Company, which has large plants in operation at Niagara Falls and at Shawinigan Falls, Quebec, Canada, and is installing a large plant on the St. Lawrence River.

The problem of smelting steel by electricity has for some time attracted the attention of inventors, and many experiments have been made to achieve the desired end. In the beginning of the year 1900 an electric steel furnace, without electrodes, was built at Gysinge, in Sweden, and its action watched with considerable curiosity as to its successful operation. After a few experiments, the first ingot was produced and the steel was found to be of an excellent quality. Thus, the problem was solved in a technical way, although considerable progress was necessary before the process could be considered a commercial success. In November, 1900, a larger furnace was built on the same lines as the first one and proved much more successful than its predecessor. In August, 1901, both furnaces were ruined by fire and the firm experimenting with them decided to build a steel works. This information comes from the Trading and Shipping Journal of Gothenburg, Sweden, and is not as complete, electrically, as might be desired. However, it is stated that in the new works a 300 horse power dynamo, direct-connected to a turbine, will furnish the current. The new furnace will hold 3,970 pounds, and its yearly output is estimated to be in the neighborhood of 1,500 tons if charged with cold, raw material. The steel made under this process is said to be of a superior quality, characterized by strength, density, uniformity, toughness and the ease with which it can be worked in cold, unhardened condition, even when containing a very high degree of carbon. Tungsten steel manufactured by this process is said to make stronger magnets than other tungsten steel and does not warp in ${ }^{-t h e}$ hardening. Microscopic experiments have shown that the electrically made steel is not different in any way from crucible steel.

Prof. McKendrick, F.R.S., has been carrying out a series of experiments with a highly sensitive galvanometer, to demonstrate electrical phenomena of muscles, nerves, and heart in certain fishes, which on account of these peculiarities are described as electric fishes. These inhabitants of the seas have the power of giving electrical shocks from specially constructed of giving electrical shocks from specially constructed
and living electrical batteries. There are in all about fifty known species of fishes that possess these electrical organs, but only the electrical properties of five or six have been studied in detail. The best known are various species of torpedo, belonging to the skate family, found in the Mediterranean and Adriatic Seas; the gymnotus, an eel found in the region of the Orinoco in South America; the malapterurus, the raash or thunderer fish, of the Arabs, a native of the Nile, the Niger, Senegal, and other African rivers, and various species of skate found in the seas around Great Britain. The electrical fishes do not belong to any one class or group-some are found in fresh water, while others inhabit the sea. They possess two distinct types of electrical organs. One closely relates in structure to muscle, as found in the torpedo, gymnotus, and skate, while the other presents more of the characters of the structure of a secreting gland, as illustrated by the electric organ of the thunderer fish. • Both types are built upon a vast number of microscopical elements, each of which is supplied with a nerve fiber. These nerve fibers come from large nerves that originate in the nerve centers, brain, or spinal cord, and in these centers are found special large nerve cells, with which the nerve fibers of the electric organs are connected, and from which they spring. Yet the electricity is not generated in the electric centers, and conveyed by the electric nerves to the electric organ, but it is generated in the electric organ itself. It is only produced, however, so as to give a shock when set in action by nervous impulses transmitted to it from the electric centers by the electric nerves. According to Prof. McKendrick, there are few departments of physiological science in which can be found a more striking example of organic adaptiveness than in the construction of the electric fishes. In these animals there are specialized organs for the production of electricity on an economical basis far surpassing anything yet contrived by man. The organs are either modified muscles or modified glands, structures which in all animals manifest electrical properties. The problem, however, of the evolution of electric organs is the same as that confronting us when we trace the growth in the animal world of any organ of sense, or for that matter of any organ in the body. Whether they are merely the result of mechanical causality or otherwise, Prof. McKendrick contends is too abstruse a problem for the supply of a conclusive explanation.

## Engineering Notes.

Prof. Slaby has demonstrated after exhaustive ex periments that the surface of the earth plays an im portant part as a conductor of Hertzian waves, for which many have heretofore regarded the air as the only conductor. He constructed an artificial earth which was immunized from external influence by cov ering the floor of his laboratory with zinc. He then experimented with waves on the floor until his theory was proved.
A recent test of Low Moor staybolt iron, made by ne of the leading American railroad companies, gave the following excellent results. Three specimens ware tested and the average figures were: Tensile strength $51,020 \mathrm{lbs}$. per square inch; elastic limit, $29,656 \mathrm{lbs}$; elongation in 8 in., 30.58 per cent.' All of the test pieces passed the hot and cold bending tests. The chemical analysis showed: Silicon, . 074 per cent; phos phorus, .083 per cent; iron, 99.43 per cent; carbon and manganese, traces; sulphur, none.
Some interesting experiments have been carried out with a new monorail system devised by a French engineer, M. Devic. The inventor has built a model upon the scale of one-tenth of what the actual train is to be and with this he has attained a speed of 13 miles an hour. The train is to be propelled by electric power, and in order that high speed may be attained, the inventor relies upon two factors-diminution of weight and a more effective grip of the driving wheels upon the single track of the railroad. The inventor claims to have designed a rail which will afford the wheels sufficient grip irrespective of the weight they may be supporting. Further experiments with a much large model are to be carried out at Nemours to prove the utility and advantages of the system. M. Devic is sanguine of attaining a speed up to 200 miles per hour
So much persistent effort has, in recent years, been expended in cutting down boiler and engine weights on warships-and not always for the best of the ser vice-that to the naval engineer there must be a good deal of satisfaction in reading a recent paper pre sented to the Institution of Naval Architects by W. H Whiting, Assistant Director of Naval Construction of the British Navy, dealing with "The Effect of Modern Accessories on the Size and Cost of Warships." The substance of Mr. Whiting's paper is that there are a hundred and one different ways, and many of them not very useful ways, in which the weight of a mod ern warship has been increased. Few of them have anything to do with the propelling power of the ship, and all of them might be carefully scrutinized and revised with the certain result of advantageously lightening the ship by a great many thousands of pounds. The fondness for unnecessarily heavy brass fittings of all kinds, for example, has often been mentioned as one of the things which might well be re stricted, and while this is only a little thing in itself it is the little things which count severely in the ag gregate. Take so insignịicant a matter as paint, for illustration! Mr. Whiting says that one who has not the records before him may well be incredulous at the enormous weight of paint worked into a ship. The most serious feature is that the process never ceases, and the greater the pride in the ship, the greater the tendency to sink her with white lead. He mentions a case in which there was removed from the inner sur face of a portion of the crew space of a destroyer paint of a weight of over two pounds per square foot. This is, no doubt, exceptional; but it may well be questioned whether all officers realize how, by a rigid economy in paint, they may not inappreciably benefit their ship. A curious development, further, has been the desire for screw gear on board ship. Not merely in rigging, but in many fittings, such as awnings, ridge-ropes, guard-chains and ropes, and in the secur ing of all kinds of gear, lashings have given place to screws and slips, which not only add directly to the weight, but impose greater strains on the fittings. The screws mean bigger awnings, bigger stanchions, and so on.-Cassier's Magazine.

## The Current Supplement.

The London correspondent of the Scientific American begins the current Supplement, No. 1442, with an article in which he describes the method by which London's "tubes" were constructed. Dr. Charles Minor Blackford discusses the new Cuban telegraphic service. The third installment of the article on the Schroeder contact process of sulphuric acid, manufacture comes from the pen of Dr. Charles L. Reese. The recent disaster which occurred on the Paris Metropolitan Underground renders rather timely a description of the details of construction of the tunnel. "Colors for Soaps and Perfumes" is the title of an article which will probably be of interest to the manufacturing chemist. Cyril Davenport tells much that is instructive and interesting on the making of mezzotints. Among minor articles may be mentioned those which describe the arduous work of the expert train dispatcher, totemism, pearls of western Europe, underwriters' laboratories, and the cultivation of India rubber trees.

## BORELLY'S COMET.

by Mary proctor.
From the time of the first observation, Boreily's comet grew brighter very rapidly and could be easily seen with the unaided eye as early as June 30 . The comet is now fading rapidly from sight, and by this time is lost in the twilight.
In the Lick Observatory Bulletin, No. 47, an ephemeris given, locating the comet on my father's Star Chart, from July 14 to September 20, makes it possible to trace the path of the comet through these points for August and September.

|  | Right Ascension. |  |  | Declination. |
| :---: | :---: | :---: | :---: | :---: |
|  | H. | M. | ${ }_{4}{ }^{\text {d }}$ |  |
| August ${ }_{3} 1.5$ | 11 | ${ }_{32}^{43}$ | ${ }_{21}^{44}$ | + ${ }^{51} 1^{\circ} 188^{\prime} .88$ |
| " $\quad 1.5$ | 11 | 21 | 50 | $44^{\circ}{ }^{\circ}{ }^{\circ} 0^{\circ} 0^{\prime}, 4$ |
| ". ${ }^{7.5}$ | 11 | ${ }_{7}^{14}$ | ${ }_{31}^{49}$ | ${ }^{44^{\circ}} 4{ }^{\circ} 51^{4}, 28$ |
| $\cdots \quad 11.5$ | 11 | 0 | 49 |  |
| " 13.5 | 10 | 54 | ${ }^{23}$ | ${ }^{39{ }^{\circ}{ }^{\circ}{ }^{\circ} 4^{\prime} .1}$ |
| " <br>  <br>  <br>  <br> 17.5 <br> 17.5 | 10 | ${ }_{42}^{48}$ | ${ }_{2}^{1 / 2}$ |  |
| "19.5 | 10 | 35 | 58 | $33^{\circ}{ }^{\circ}{ }^{\prime}, 2$ |
| "  <br> 1.5  <br> 23.5  | 10 | $\stackrel{29}{29}$ | 54 | ${ }^{332^{\circ}}{ }^{\circ} 7^{\prime} .0$ |
| " <br> 2.50 .5 | 10 | 24 18 | 3 30 |  |
| $\cdots \quad 27.5$ | 10 | 13 | 31 | $24^{\circ} 47 \%$ |
| ، 29.5 | 10 |  | 20 | 210 ${ }^{\circ} 54^{\prime \prime} .6$ |
| ". September ${ }^{31.5}$ | 10 | ${ }_{3}$ | ${ }_{36}^{59}$ |  |
| September $\quad$ \% 4.5 | 10 | $\stackrel{3}{2}$ | ${ }_{1}$ |  |
| 6.5 8.5 | 10 | 1 | ${ }_{50}^{8}$ |  |
| " 10.5 | 10 | 1 | 2 | ${ }_{3} 3^{\circ} 50^{\circ} 0^{\circ} .8$ |
| " ${ }^{\prime} 12.5$ | 10 | 1 | ${ }^{37}$ | ${ }^{\circ}{ }^{2}{ }^{2} \cdot 4$ |
| ". | 10 | ${ }_{3}^{2}$ | ${ }_{35}^{27}$ |  |
| " 18.5 | 10 | 4 | ${ }^{53}$ | - $6^{\circ} 58^{\circ} .7$ |
| " 20.5 | 10 | 6 | 19 | - $9^{\circ} 29^{\prime} .5$ |



From July 14 to 30, the comet passed from Cygnus through the constellation of Draco to Ursa Major where it was located for a while near the bowl of the so-called Great Dipper. From July 30 to August 27 it passes from Ursa Major, through Leo Minor, and will be south of Gamma in Leo by the 27th. This is the date of its nearest approach to the sun, its peri helion distance being $31,000,000$ miles. On September 2 it will be half-way between Gamma and Alpha (Reguus) in Leo, and by September 8 it will be in Sextans, ninsignificant group of stars midway between the con stellations of Leo and Hydra. By the 20th it will have reached Hydra, being several degrees southeast of Alphard, which marks the heart of the monster, and lose to Alkes in the Crater
It will be seen, by glancing at the map for August (Map VIII., in my father's "Half Hours With the Stars"), that as Leo sets in the northwest early in the evening, the comet is no longer visible, being below the horizon at that time. A glance at Map IV., how ever, will give an idea of the path of the comet, if we draw an imaginary line (indicated by a dotted line in the map) passing from Cygnus, in the upper par of the map, through Draco, Ursa Major, Leo, ind end ing at Alkes above Hydra.
Prof. Barnard, of the Yerkes Observatory, has made a good series of photographs of the comet, with a lens only $11 / 2$ inches diameter. This shows the comet with a tail 20 degrees long. On July 24 the tail seemed to break off some three degrees back of the head. In a photograph taken July 30, the tail appeared single.
There is nothing specially remarkable about the comet, and it has been a disappointment to those who have watched for a display. Nevertheless the head has been as bright as that of many a great comet, though the tail visually has kept faint. The nucleus has not been at all active. Everything depends upon the activity of the nucleus, as ar as a display is concerned.

Newton's law of gravitation, which states that two bodies attract each other with force inversely proportional $t$ o he square of th istance betwee them, has been made the subjec of an exhaustive nvestigation b Prof $E$ W Brown, of Have ord College. Prof Brown announce that his calcula tions show that Newton's laws represent the mo tion of our moon to within one millionth of one
per cent and that no other physical law has been ex pressed with anything like the precision of its simple statement.

## OBSERVATIONS OF BORELLY'S COMET AT LICK OBSERVATORY.

The comet discovered on June 21 by Astronomer Borelly at Marseilles, though invisible to the naked eye at time of discovery, was a conspicuous object in the evening sky in the latter half of July. The nu


Borelly's comet, July 15. 1903.
maytay PHOTOG COMET.
the motion of the comet was followed by Stars appear as lines, because the motion of the comet was followed by
cleus was considerably brighter than a fourth-magnitude star, and at first sight most observers would mistake it for a star. A closer examination, however, showed that it was very hazy in appearance and had a considerable diameter. In our clear skies, a tail some 4 degrees in length was visible to the naked eye. The power of the photographic plate was such that a maximum length of tail of some 10 degrees was recorded. The distance of the comet from the earth at the time was about 36 million miles, and the linear length of the tail observed was approximately six million miles.

The accompanying photographs were made on July 15 and July 20. The tails should be shown by them to have a length of 4 inches or more, corresponding to about 7 degrees. The difficulty of reproduction is so great that it is doubtful if the reader can trace them to that extent. The comet was moving rapidly among the stars during the long exposure, and inasmuch as the telescope was caused to follow the nucleus of the comet very closely, the surrounding star images are drawn out into straight lines.

The original negatives show that the details of structure in one photograph are wholly different from those in the other. Comet photography of the past ten years has determined the fact that the tails under-
go very rapid transformations. The structure of one night is often entirely replaced by a different one the next night. Some force residing in the sun evidently exerts a repulsion upon the finely divided matter ejected from the head, in such a way that this material is driven in a direction opposite from the sun, and with such speed that in twenty-four hours it is usually lost in space and an entirely new tail has replaced it.
Spectroscopic observations of the present comet show that a large portion of its illumination is due to reflected sunlight; other components are due to the presence of carbon and nitrogen vapors; still others are due to the presence of vapors not yet identified.
The relation of comets to other stellar bodies, so far as their origin and the history of their development is concerned, remains extremely obscure. Why the sun should so powerfully increase the activity within a comet is entirely unknown. It has recently been proven, however, that light and heat falling upon any surface exert a minute pressure upon that surface, very much in the same way that a breath of air exerts a pressure. The supposition that these forces of light and heat acting upon the highly rarefied comeary matter may develop it in size and activity, and repel the gases in such a way as continuously to form a tail, is a most interesting and promising one.
The orbit of the comet was very accuratel.y computed by Prof. Perrine, who found that it is moving in a parabola. It is difficult to supply a drawing showing the position of the comet's orbit with reference to the orbit of the earth, for the reason that the plane of the former makes nearly a right angle with that of the latter; to be exact, the angle between the two planes is 85 degrees. The comet has come into the solar system practically from an infinite distance, and will retire from our system never to return. The point of nearest approach to the sun will be reached on the vening of August 27, at a distance of 31 million miles. Before the publication of this note it will, no doubt have been lost to view for a time on account of its nearness to the sun.

Metal in Yacht Construction.
The hulls of large racing yachts present many problems other than the general design and the lines. The question of material is one which constantly troubles the marine architect. It now seems that luminium and manganese bronze are to have a competitor, if the accounts in the newspapers prove to be worthy of credence. It is said that a new metallic element (?) has been discovered and has been christened "selium." From the meager information available it seems that the new metal has certain properties which will render it invaluable for-air-ship and yacht construction. It is said to be lighter and stronger than aluminium and the cost is only one-twelfth as much On August 8, 1903, aluminium 99 per cent pure, in in gots, was quoted at 33 to 37 cents a pound in ton lots This would make selium about 3 cents a pound. This compares quite favorably with pig-iron, which is quoted at $\$ 18.25$ a ton at tidewater. It is extrāordinary that new metal should be produced at once at such an astonishingly low price. We are used to having new elements doled out from the laboratories at about $\$ 5$ a look, and now we have a whole pound for 3 cents We should be more inclined to credit the discovery if it was given to the world in a more legitimate manner It is not, however, its cheapness which will commend it to the yacht designer. It does not rust and takes a fine polish like nickel. If it should be found that it will not pit under the infiuence of sea water and that no elec rolytic action sets in, it will be an ideal material for the maker of hulls to conjure with. It still re mains to be seen if Mother Nature has been good to Messrs. Herres hoff, Fife, and Watson.

A decree is published fixing May 1, 1904, for pre senting tender in Santiago for the construction of the Chilian section of the Transandine Rail. way. The gov ernment guaran tees 5 per cent on a capital not ex ceeding \$7, 500,000 .


Fig. 1.-Lead Mills and Mixers.


Fig. 3.-Macnunes for Grooving and Molding the Wooden Casings.


Fig. 5. Hand Polishing the Finest Pencils.



Fig. 2. - The Lead Presses.


Fig. 4.-Gluing the Leads in Their Casings


Fig 6-Stamping the Pencils.


## THE MAKING OF A LEAD PENCIL.

The lead pencil, so generaily used to-day, is not, as its name would imply, made from lead, but from graphite. It derives its name from the fact that prior to the time when pencils were made from graphite, metallic lead was employed for the purpose Graphite was first used in pencils after the discovery in 1565 of the famous Cumberland mine in England. This graphite was of remarkable purity and could be used without further treatment by cutting it into thin slabs and incasing them in wood.
For two centuries England enjoyed practically a monopoly of the lead-pencil industry. In the eighteenth century, however, the lead-pencil industry had found its way into Germany. In 1761 Caspar H 'aber, in the village of Stein, near the ancient city oif Nu remburg, Bavaria, started in a modest way the manufacture of lead pencils, and Nuremburg became and remained the center of the lead-pencil industry for more than a century. For five generations Faber's descendants made lead pencils. Up to the present day they have continued to devote their interest and energy to the development and perfection of pencil making. Eberhard Faber, a great-grandson of Caspar Faber, immigrated to this country, and, in 1849, established himself in New York city. In 1861, when the war tariff first went into effect, he erected his own pencil factory in New York city and thus became the pioneer of the lead-pencil industry in this country. Since then four other firms have established pencil factories here. Wages, as compared to those paid in Germany, were very high, and Eberhard Faber realized the necessity of creating labor-saving machinery to over come this handicap. Many automatic machines were nvented which greatly simplified the methods of pencil making and improved the product. To-day American manufacturers supply nine-tenths of the home demand and have largely entered into the com petition of the world's markets.
The principal raw materials that enter into the making of a lead pencil are graphite, clay, cedar and rub ber.
Although graphite occurs in comparatively abundant quantities in many localities, it is rarely of suffi cient purity to be available for pencil making. Oxides of iron, silicates and other impurities are ound in the ore, all of which must be carefully separated to insure a smooth, serviceable material. The graphites found in Eastern Siberia, Mexico, Bohemia, and Ceylon are principally used by manufacturers. The graphite, as it comes from the mines, is broken into small pieces, the impure particles being separated by hand. It is then finely divided in large pulverizers and placed in tubs of water (Fig. 1), so that the lighter particles of graphite float off from the heavier particles of impurities. This separating, in the cheaper grades, is also done by means of centrifugal machines, but the results are not as satisfactory. After separation the graphite is filtered through filter-presses.
The clay, after having been subjected to a similar process, is placed in mixers with the graphite, in proportions dependent upon the grade of hardness that is desired. A greater proportion of clay produces a greater degree of hardness; a lesser proportion increases the softness.
Furthermore, the requisite degree of hardness is obtained by the subsequent operation, viz., the compressing of the lead and shaping it in to form ready to be glued into the wood casings (Fig. 2). A highly com pressed lead will produce a pencil of greater wear ing qualities, an important feature in a high-grade pencil. Hydraulic presses are used for this purpose; and the mixture of clay and graphite, which is still in a plastic condition and has been formed into loaves, is placed into these presses. The presses are provided with a die conforming to the caliber of the lead desired, through which die the material is forced. The die is usually cut from a sapphire or emerald or other very hard mineral substance, so that it will not wear away too quickly from the friction of the lead...The lead leaves the press in one continuous string which is
cut into the lengths required (usually seven inches for the ordinary size of pencil), placed in crucibles, and fired in muffle furnaces. The lead is now ready for use, and receives only a wooden case to convert it into a pencil.

The wood used in pencil making must be close and straight grained, soft so that it can readily be whittled, and capable of taking a good polish. No better wood has been found than the red cedar (Juniperus virginiana), a native of the United States, a durable, compact and fragrant wood, to-day almost exclusively used by pencil makers the world over. The best quality is obtained from the Southern States, Florida and
pencils meanwhile drying, and are emptied into a re ceptacle. When sufficient pencils have accumulated, they are taken back to the hopper of the machine and the operation repeated. This is done as often as is necessary to produce the desired finish. The better grades are passed through ten times or more. Another method is that of dipping in pans of varnish, the pencils being suspended by their ends from frames, immersed their entire length and withdrawn very slowly by machine. A smooth enameled effect is the result. The finest grades of pencils are polished by hand (Fig. 5). This work requires considerable deft ness; months of practice are necessary to develop 2 skilled workman. After be ing varnished, the pencils are passed through ma chines by which the accumulation of varnish is sand-papered from their ends. The ends are then trimmed by very sharp knives to give them a clean finished appearance
Stamping is the next op eration (Fig. 6). The gold or silver leaf is cut into narrow strips and laid on the pencil, whereupon the pencil is placed in a stamp ing press, and the heated steel die brought in contact with the leaf, causing the latter to adhere to the pen cil where the letters of the die touch. The surplus leaf is removed, and, after a final cleaning, the pencil is ready to be boxed, unless it is to be further embellished by the addition of a metal tip and rubber, or other at tachment.
In this country about nine-tenths of the pencils are provided with rub nine-tenths of the pencils are provided with rub-
ber erasers. These are either glued into the wood with the lead, or the pencils are provided with small metal ferrules (Fig. 7) threaded on one end into which the rubber eraser-plugs are inserted These ferrules are made from sheet brass, which is cupped by means of power presses, drawn through sub sequent operations into tubes of 4 or 5 inch lengths, cut to the required size, threaded and nickel-plated Eberhard Faber has a large number of these presses which are continually operated for this purpose alone The rubber plugs used in these pencils are but one of many rubber products (erasers, bands, and the like) made in the $E$. Faber factory in Newark. These ar ticles are all made from pure Para gum, which is thoroughly masticated in huge powerful masticating machines (Fig. 8), then cured, mixed with sulphur and the necessary ingredients to add to its era
sive qualities, and vulcanized. The rub ber is molded, and in some cases cut, to the required sizes (Figs. 9 and 10).

The Pennsylvania Railroad tunnel unde the Hudson River was begun on June 25 . The tunnel work is divided into two sec tions, known as the northern and the east ern sections. The first drill holes for the first shaft were started at noon at the foo of 32d Street and Eleventh Avenue, New York.

In addition to being an ill-smelling, nox ious plant, the jimson weed (Datura stra monium), also known as stinkweed and stinkroot, has distinctly poisonous proper ties and should be exterminated wherever growing. It is recommended by the poison plant specialists of the Department of Ag riculture to mow the weed while in blos som. The seeds are especially poisonous, and fatal cases are known of children eating them. Poisoning can also be produced by sucking the flower, which is an attrac-tive-looking, very light lavender blossom. Cattle in a few instances have been pois oned by eating the leaves of young plants
through sanding machines to provide them with a smooth surface.
After sandpapering, which is a necessary preliminary to the coloring process, when fine finishes are desired, the pencils are varnished by one of several methods. That most commonly employed is the mechanical method by which the pencils are fed from hoppers one at a time through small apertures just large enough to admit the pencil. The varnish is applied to the pencil automatically while passing through and the pencils are then deposited on a long belt or drying pan. They are carried slowly a distance of about twenty feet, the varnish deposited on the


Fig. 10.-Boxing the Rubber Bands.
the maring of a lead pencil ere present in grass hay, but these animals eithe avoid the plant or are very resistant to its poison Young plants do not contain a large proportion o poison.-G. E. M.

The Russian Department of Agriculture is offering wo prizes for the best separators of average dimensions and capable of treating from sixteen to twenty gallons of milk an hour. The competition is open to foreigners, and entries must be made before February 8 . (new.style), 1904. The prizes will be 1,500 rubles and 500 rußles, or about $\$ 825$ and $\$ 275$ respectively.

## ALFALFA ON WESTERN CATTLE RANGES,

 by day allen willey.The prediction is made that the choicest beef and mutton served on the tables of the world will be raised within a few years on the great pastures of the West and Southwest. It is known in a general way that live stock has been considerably improved recently by the modern systems which are employed on ranches; for no longer is the flesh driven off the bones of the cattle in forcing them to go mile after mile over plain and valley in search of new feeding grounds. Many of the ranches of to-day are divided into pastures, which, though perhaps covering 50 or 60 square miles in extent, are provided with an abundance of fodder.
While the majority of the great herds and flocks of the West as yet are of medium and low grade stock, the tendency is to breed a higher grade of animals; for the ranchmen have realized that they can grow a kind of food which is especially suitable for such varieties as Herefords, Devons, Holsteins, and Durhams in cattle, as well as even Merino and Southdown sheep. This food is alfalfa, which is perhaps one of the greatest blessings which has been bestowed upon the western farmer and stock raiser. Alfalfa is another name for lucerne and in the Southwest is called Spanish clover, because its foliage resembles this clover to a certain extent. It is an attractive plant and only a few years ago was considered far more ornamental than useful. Now, however, it has been discovered that not only horses and mules but cattle and sheep thrive upon it and
many as seven crops have been gathered in Colorado and New Mexico when special attention is given it. The seed is planted in the spring of the year, about 25 pounds being enough for one acre. The ground is first prepared by plowing and after the seed is in, it is kept fairly free from weeds until the plant secures


An Artesian Well fur Irrigating an Alfalfa Field.
for the average cost of the seed, cultivation, harvesting and stacking is only about $\$ 1.50$ a ton, where four crops are gathered in a season. One reason for the low cost of making the crop is that the ordinary horse cultivators and harvesters can be used, thus saving time and labor. It grows so luxuriantly that a few weeks after the seed is sown, the plant may be knee-high, and sometimes waist-high in the field. Cattle and sheep eat it with the same relish whether standing green in the field or pulled dry from the stack. After the harvest, sometimes hogs are turned into an alfalfa pasture and they actually fatten on it. It not only makes flesh, but a fine quality of flesh. Beet and mutton fed on it have an excellent flavor, usually superior to that coming from the ordinary ranches, where various grasses are depended upon for food, and where corn is also used for fattening.
The reports made to the Department of Agriculture from the various irrigated districts in the West show a surprisingly large number of flocks and herds of high-grade animals. In fact the proportion in these sections is much larger than elsewhere in the country beyond the Mississippi River. It is due to the fact that the irrigation farms are raising so much alfalfa. In the Pecos Valley in New Mexico there are herds aggregating 500,000 head of Hereford and
a start, when it does its own weeding. In fact it is very independent and practically takes care of itself until it is ready for the blade of the harvester. It can be piled or stacked like timothy or any other forage crop, and when properly piled in a field is proof

Durham cattle alone. Some of the single herds con tain 30,000 animals, while it is estimated that fully half a miilion blooded sheep are contained in the flocks which graze in the same vicinity. In the valley of the South Platte, Colorado, are also immense


Western Cattle, Raised on Reclaimed Desert Land and Fattened with Alfalfa.
will eat it in preference to any other grass that grows. The farm experts say that it contains as much nourishment for live stock as corn and is as good as the best timothy or other ordinary hay.
Alfalfa is an importation, being brought to the United States first in 1842 , when some seed secured from France was planted in New Mexico. The first harvest was considered of little value and for a number of years the crop was neglected, but the vegeta tion from the first field began spreading over that portion of the State until to-day there are many miles of territory upon which nothing else is grown. It is especially adapted to the arid lands of the West, for it grows luxuriantly with a very small amount of moisture In the irrigated districts it has become one of the principal forage crops and is as extensively raised in Colorado as in the southern part of the country and more and more is being raised as the farmers appreciate its value.
Alfalfa grows so rapidly that in six months the mower can go over the field four or flve times and cut off from $11 / 2$ to 2 tons an acre at each harvest. As


Pens on a Western Sheep-Ranch, where the Animals are Fattened with Alfalia, ALBALPA ON WESTERH CATTLE RAMGEG.

A Field of Clover.
droves of blooded animals and fully 100,000 cattle are now being sent to Kansas City, St. Louis, and Chicago which have been raised almost entirely on alfalfa The packers pay the highest market price for these grades. They are largely exported on the hoof and in carcasses and many an Englishman dines on roast beef "made in America," but coming from stock which originally was raised in Devonshire or perhaps Durham.
The tendency among the western cattle growers is to raise more quality and less quantity, and for this purpose a number of very valuable herds of pure-blooded stock have been imported within the last few years from Great Britain. Nearly every large ranch has at leas one or two registered bulls and as fast as possible live stock growers are improving their straln. There should be no dan ger, however, of a meat famine on account of this revolution in cattle rais ing, for last year government statistics showed fully $25,000,000$ beeves, nearly $50,000,000$ sheep, and about $30,000,000$ hogs owned by farmers and ranchmen in the United States.

## FLOWERS OF PREY.

## by J. CARTER beakd.

Probably in some respects the most surprising result of late entomological exploration is the discovery of semblances of orchidaceous flowers endowed with animal life and voracious carnivorous appetites, that seize and incontinently devour insect vegetarians which, allured by their form and color, incautiously alight upon them. These flower insects belong to the curious family Mantidæ, of which we have a well-known member in our southern States, Phasmomantis Carolina, commonly called "praying mantis," though if the flrst part of the name was spelled with an " $e$ " instead of an "a," it would be far more appropriate, since no known insect is more bloodthirsty and destructive of smaller and weaker individuals belonging to its class. Its form is characteristic of its predatory habits. The mantis is really a four-legged insect, for the fore limbs are so modifled that they cannot under any circumstances be used in walking and are no more properly termed legs than would be the arms of men or the wings of birds. They are, in fact, the natural weapons of the insect and are used for nothing else than flghting a nd fighting a n d for capturing
prey. The insect shown at Fig. Upper Part of American Mantis with 2, discovered an Insect Which It is About to Devour. by Wood Mason, masquerades sometimes as a pink and at others as a white orchid. The whole flower insect is either conspicuously white or of a resplendent pink color, and both in color and form perfectly imitates a flower. The lower or apparently anterior petal of an orchidaceous blossom, the labellum, often of a very curious shape, is represented by the abdomen of the insect, while the parts which might be taken, regarding it as an insect, for its wings, are actually the femurs of the two pairs of posterior limbs, so greatly expanded, flattened, and shaped in such manner as to represent the remaining petals of the flower. As the mantis rests, head downward, amid the stems and leaves of a plant, the fore legs drawn in so that they cannot be
seen, the thighs of the two hind ones radiating out on each side and the thorax and the abdomen raised at right angles to each other, the insect might easily at first sight deceive more discriminating ento nating ento mologists than the honeyseekers that settle upon it. An allied species, exactly resembling a pink orchid, is mentioned by D r. Wallace, on the author ity of Sir Charles Dilke, as inhabiting Java. Its speJava. Its spe-
cialty is allurcialty is allur-
ing and capturing butterflies. The expected guest having arrived, the seeming feast spread out for his delectation arises and devours him. Prof. S. Kurz, while at Pegu, in lower Burma, saw what he supposed to be an orchid of a species unfamiliar to him, but upon examination found it to be a mantis of the genus Gongylus. As is common with the habit of its kind when alighting upon a plant, it hung head downward. exposing the under surface to view, sometimes motionless, and sometimes swaying gently like a flower


Deroplatys Sarwace, from Borneo.
touched by gentle zephyrs. A bright violet-blue dilation of the thorax, in front of which its fore legs, banded violet and black, extended like petals, simulated the corolla of a papilionaceous flower so perfectly as to deceive the eyes of a practised botanist. An account is given in the proceedings of the Asiatic Society, Bengal, of a number of specimens of this mantis in the possession of Dr. J. Anderson. These insects came from Mindipur. Santal women and children had


Deroplatys Truncata (Truncated Mautis), from Singapore.
collected them from the tiwigs of a bush where they were hanging and brought them alive to a Mr. Larymore, who forwarded them to Mr. Buckland, who in turn gave them to the doctor.

They are said to particularly frequent rose bushes, and at Mindipur are known as rose-leaf insects. Their wings, when the mantis is mature, are furnished with foliaceous expansions that perfectly counterfeit rose leaves. They were fed upon flies and grasshoppers, preferring the flies because the grasshoppers were evidently too vigorous for them to easily manage. The insects were immature; they did not exhibit, looking at their upper surfaces, any particularly striking peculiarities, except the leaf-like dilation of the prothorax, and the foliaceous appendages to the legs, all of which, together with the rest of the upper parts of


Curious Orchid Lately Discovered by Wood Mason.

## FLOWER TRAPS.

the insect, was green. On the other hand, the mantis presents an entirely different appearance when its under surface is exposed to view. The leaf-like expansion of the prothorax, instead of green, presents a pale, clear lavender-violet hue with a faint pink bloom along the margin. The resemblance to the corolla of an orchidaceous flower thus presented is perfected by the presence of a dark brown spot in the middle over the prothorax or breast, which looks precisely like the
mouth of the tube of a corolla. In addition to this, the long, slender upper part of the prothorax re sembles a flower, while the fore limbs, when resting drawn up in the center of the corolla, add to and heighten the imposture.
The curious forms shown in our illustrations belong to the same genus, Deroplatys, although the first is a native of Singapore, south of the Malay Peninsula, while the Sarawaca is from Borneo. In these species the outspread wings simulate the petals of a flower. A whole tribe of spiders, members of the Thomisadæ family, living in flower cups, assume the colors and markings of the flowers in which they lie in wait for victims.
Blossoms of the Vibernum lantana, a European shrub having large ovate leaves and dense cymes of small white
 flowers, and it may be added, our American species (Vibernum lentago), or sheep berry, also bearing broad, flat clusters of white flowers, are at times occupied by spiders of the same creamy - white hue as that of the blossomas, and their glo bular abdothe unopened buds (of which Immature Form of Rose-Leaf Mantis of there are many in each cluster) not only in color but in shape and size. These sipiders spin no web, depending upon strategy to secure their prey, and live upon their insect visitors. Later in the season spiders apparently identical with these, except in color, are found in the blossoms of the Orchis maculata. The spiders found here have dark reddishbrown spots on the abdomen; and in the position usually assumed by it, the Aranima, standing with de pressed head, closely mimics in shape and size, in relative position, and a little way off in color, the dark purple pollinia of the flowers. Recent investigations render it extremely probable that, as flrst sug gested by Prof. Nottridge, as the season advances, these spiders change color, and that each successive change adapts them for concealment in the flowers of some particular plant. The Thomisus citrens poses itself in $t h e$ midd'le of a composite flower with legs expanded like its exterior ray. They have been observed in orchida. ceous flowers with their legs expanded horizon.tally. Honeybees as well as other in . sects have been found in their murderous clutches.

Brazil. ian birds, flycatchers, display a brilliantly colored crest easily mistaken for a flower cup. Insects, attract. ed by what appears to be a freshly opened blossom, furnish the birds with food. An Asiatic lizard is entirely colored like the surface of the desert plains where it lives, except that at each angle of the mouth blooms a brilliant red folding of the flesh exactly resembling a little flower that grows in the sand. Insects lured by the seeming flower are incontinently disillusioned when they settle upon it.

In the city of New York there are only 737,477 white persons born of native parents.

RECENTLY PATENTED INVENTIONS. Electrical Devices.
ELECTRIC AUTOMATIC GAS LIGHTER AND SHUT-OFF.-H. J. Lyons, Guyandotte, W. Va. This invention relates to an electric
automatic gas lighter and shut-off, Mr. Lyon's automatic gas lighter and shut-off, Mr. Lyon's main object being to provide for igniting a
plurality of burners stationed at different points and to provide for automatically shutting off the gas, so as to prevent the gas being turned on again under conditions of danger. The small motor in this contrivance may be made with permanent magnets so as to
reduce the cost of the batteries to a minimum reduce the cost of the batteries to a minimum
An independent circuit can be added for th separate lighting of individual burners.
SPHEROIDAL STRAIN.-L. Steinberger, New York, N. Y The invention relates to electrical strains, the inventor's more particular
object being to produce a neat, compact, and object being to produce a neat, compact, and
efficient device capable of being used either efficient device capable of being used either
with or without the outer envelope or insulamachine shops, for the reason that the link in be either drop-forged or cast from malleable iron.
Single-Link Strain.-L. Steinberger New York, N. Y. This improvement belongs to insulated electrical strains used for outdoor of a strain embodying a high degree of sim plicity, neatness, cheapness, and general ef ficiency. It further relates to the production single "metallic link."
SUSPENSION-FINTURE.-L. Steinberger, New York, N. Y. The invention in this patent has reference to a suspension-fixture to be railways, and more particularly as a device capable of serving as a turnbuckle, a strain and a clip support; and the object of the inventor is to produce a device capable of serving
in one or more of the capacities mentioned.

## Engineering Improvements.

 SUCTION-VALVE FOR COMPRESSORS. E. A. Menking, Pittsburg, Pa. The presen invention pertains more especially to spring controlled puppet or suction valves, such as areemployed in connection with cylinders of air employed in connection with cylinders of air,
gas, or other compressors or the like; and the principal object is to provide a valve structure of this character which is effective structure of this character which is eperation and which may also be reguted with facility, whereby no hammering or noises
are produced by the valve when the same is in are.
RANGE-Finder.-G. Griffith, San Francisco, Cal. The object in view of the inven-
tion is to furnish a new and improved rangeinder for the use of surveyors, marine officers and other persons and arranged to indicate the distance of an object from the observer located
PIPE.-O. Berger, Galveston, Texas. Stated PIPE.-O. Berger, Galveston, Texas. Stated
broadly, this invention consists of arranging the fluid or gas conducting plpe within a larger pipe is concentrically supported, providing uni plpe is concentrically supported, providing uni
form surrounding space between it and the uter pipe, adapted to receive insulating-packing, or for cfiective flow or cold fluid around the inner pipe, according to whether its contents are to be cooled or heated.
EX CY,OSIVE-ENGINE.-W. Walke, Joplin, Mo. Mr. Walke's invention has reference to iniprovements in explosive-engines of the two cycle class, the engines being adapted for service in either a horizontal or a vertical posi-
tion. The engine has its parts arranged for tion. The engine has its parts arranged for tion of the structure, thus especially adapting for service on motor driven vehicles.
MOTOR.-J. W. Garrett, New York, N. Y The inventor's improvement in this patent refers "particularly to that class of motors known as "gas" or "explosive" motors, his object being converting a steam or similar pressure engine of the ordinary slide-valve type into a gas-motor of high power
bOILER-SETTING.-S. W. Davis, Pickens, W. Va. In this case the invention resides in a manner of constructing walls adapted especially for covering or setting boilers, although
it is applicable to various other purposes, as it is applicable to various other purposes, as
will suggest themselves to skilled mechanicswill suggest themselves to skilled mechanics-
for example, it could be used in wall construction in the art of house-building.

## Hardware.

PERMUTATION-LOCK.-R. L. Benton. and W. R. Benton, Salida, Col. The object claimed n this invention is the provision of simple novel details of construction for a lock that adapt it for reliable service to secure a door
in closed adjustment, dispense with a key, thus which is devola of a cesplosives for de stroying the lock when it is in locked condition.

Heating Apparatus.
FIRE-BOX FOR FIREPLACES.-J. J. M. Lange, Svendborg, Denmark. The design in avoid the drawbacks in well-known types of slow-combustion stoves. This result is obtained
which the combustion takes place from above downward, comprises a container for the fuel, having openings for the introduction thereo and for the passage of air, and in which con tainer the remaining embers can by means of
a turning movement be pushed upward and turning movement be pushed
spread out over the fresh fuel.

Machines and Mechanical Devices. HOIST, RAISED TRACK, AND DUMPING device.-W. R. Strickler, Jewell, Kan The object of this device for loading hay, grain,
and other materials into barns or other buildand other materials into barns or other buildngs and places, is to provide an improved horse-power hoisting device, very effective and
automatic in operation, and arranged to utilize the power applied to the fullest advantage, and to automatically trip off a load and cause return of the load-carrier to the starting posi-
iCe-making machine.-R. F. Learned, Natchez, Miss. The improvement relates to into blocks of ice in suitable cans: and relat more particularly to apparatus wherein air o gas is admitted to the water during the freezing operation in order to deaerate the water and to produce a solid and practically, core-
less block of commercial ice. Such an apless block of commercial ice. Such an ap-
paratus is disclosed by a prior application for paratus is disclosed by a
APPARATUS FOR RAISING LIQUIDS FROM WELLS.-T. F. Moran, of De Young, and F. J. Moser, Kane, Pa. The invention reates to apparatus for ralsing liquids from the kind uscd in the oil regions for raising iquids, such as oil and water, from oil-wells. It also relates to mechanism for cleaning the sand and other impurities from the well, and also to render the main valve, used in the
bottom of the well, more readily accessible. WORD - COUNTING ATTACHMENT FOR TYPE-WRITERS.-J. G. Coleman and L. Wilhite, Cleburne, Texas. The present invention relates to improvements in word-counting or registering attachments for type-writing machines, the object being to provide a device may be readily attached to the machine and by means of which the number of words printed will be accurately indicated
Spool-CUTTING LATHE.-G. A. Ensign, Defiance, Ohio. Mr. Ensign's invention has reference to woodworking machinery; and the inventor's object is to provide a new and improved spool-cutting lathe more especially de
signed to finish roughened-out spools in a very simple manner, rendering the spools uniform in shape and finish and allowing the finishing o spools of different shapes and sizes
wavemotor.- J. C. Hergenhan and C. C. Von Der Ahe, New York, N. Y. 1- this patent ful invention relates to certain novel and useful improvements in the construction of an by waves designed to utilize motion imparte by waves. The object is rne provision of
mechanism which may be readily assembled mechanism which may be readiy assembled
upon a hull or float of the desired character and which shall be so constructed that it shall be positive in its operation and simple in construction.
MECHANICAL MOVEMENT.-J. H. HUSSEy, Spokane, Wash. Broadly stated, this invention comprises mechanism interposed be-
tween the driving power and the work it optween the driving power and the work it op-
erates upon whereby the power derived from a reciprocating motor is evenly delivered to the work: Taking for illustration the commonest form of motor now in use, the steam-engine, it
is well known that the power derived thereis well known that the power derived the ac
from is delivered with constant variation, cording to the position of the crank-shaft of the engine, position of the piston, etc.

## of Interest to Farmers

MACHINE FOR LOADING AND STACKING HAY OR THE LIKE.-S. MITsch, Woodbine, Kan. One of the principal objects of the grain, or the like may be loaded upon the grain, or the like may be loaded upon the
machine while the latter is in motion, and machine while the latter is in the melevation of the load is effected during the movement of the apparatus toward the stack.
SACK-SCALE.-G. A. Archambault, Clare, Mich. Comprised in this improvement is a supporting-frame which is capable of adjustable
attachment to a bin, wagon, or the like, and which carries a scale-beam. To the beam is attached the bag-holding device. By means of this invention grain may be shoveled readily
into the bag and at the same time weighed, into the bag and at the same time weighed, after which the bag may be tied and a second
filled, the work being carried on quickly and filled, the wo
conveniently.
Plow.-J. N. Hatchfr, Mokane, Mo. The purpose in view in this improvement is the provision of a plow that may be readily
changed to form either a sulky or walking changed to form either a sulky or walking tide, in connection with the plow, a soll-cut-
ting or turning disk or moldboard so attached that it may be swung to operate on either side of the plow.

## of Mining Interest

SHEET-METAL CLAMPING-BAND WITH FOR PIPE-UNIONS.-E. WIrtz, Schalke, GerFOR PIPE-UNIONS.-G. WIRTZ, Schalke, Ger-
many. This invention has relation to certain
novel and useful improvements in a device for uniting cylindrical pipes, and in particular to used for pipes and butt-joints-such as are places. This clamping mines and for other manufactured in great quantities at compara ively little expense.
BUMPING-SCREEN.-H. L. King, Denver, Col. This is a screen for classifying and sizing ores in milling. The invention includes in connection with a supporting frame, screanhangers located below the weight of a screen-
body and so disposed relatively to the main body and so disposed relatively to the main
frame and the screen whereby a vertical rolling movement of the screen is effected simul taneously with the longitudinal movement o thrust thereof.
TREATMENT OF ORES CONTAINIING GOIDD, SILVER, COPPER, NICKEL, AND ZINC.-H. Hirsching, San Francisco, Cal. This is a process whereby the metals of
complex and refractory ores and tailings can complex and refractory ores and tailings can copper, nickel, and zinc can be produced sepa rately and economically. The process is a continuous hydrometallurgical process, using thereof, and is carried on in a simple appa ratus for which a separate application has been filed by Mr. Hirsching.

Pertaining to Vehicles.
VEHICLE FRAME AND DRIVING AXL GEAR.-GEORGE R. Boclding, Wells, Nev
Mr. Boulding's invention provides means of connecting the front as well as the rear axter
of an automobile to the driving motor. This is permitted by the use of an improved type steered independently of the front axle, and the outer wheel may turn faster than the in vehicle in turning a curve. The frame of the ride easily over an uneven road with all fou wheels continuously in contact with the REACH OR COUPLING-POLE FOR VF hicles.-J. Preuitt and C. W. F. Glander Wahpeton, N. D. The principal object of this invention is the provision of a reach or
coupling-pole for wagons and similar vehicles which is extensible as to length, whereby the same may be adapted to vehicles in which between the axles thereof or between the rear ward axle and the usual bolster above the for ward axle of the vehicle
SPROCKET-TOOTH.-R. O. WIGLEY, Brew ton, Ala. In the present case the improvement consists in making the central tongue of a securing it within a socket of the fork portion by the same bolt which fastens the sprocket to the wheel. By this construction a great
saving in sprockets is made, for as the pulling strain and wear come only on the central ongue it is only necessary to renew the tongu having to cast away or change the positio of the entire sprocket.

Rallwaye and Their Accessories. METALLIC RAILROAD-TIV. - J. K Thoma, Cooperstown, N. Y. The purpose o this inveads so constructed that rails of fo description will be firmly held in place and the locking device for the rails utilized not only to hold the rails upon the ties, but also to anchor the ties and to prevent the ties
and rails from creeping or moving from thei set position
CAR-DOOR.-F. L. Monson, Christine, N. D. In this patent of Mr. Monson the inven-
tion has reference particulariy to doors for grain-cars, and the object of the improvemen is to provide a metal door of very light maerial, and therefore easy to handle or oper ate, and, further, to
the door grain-tight.
DERAILER.-M. P. Layton and J. W. Van Doren, Minonk, III. In this case the invention relates to a device for running rail
way rolling-stock from the rails. It is ap plicable in various connections, particularly on sidings or switches, so as to prevent the cars on the switch from being run back accidentally onto the main track. The entire action of the derailer is automatic.

## Miscellaneous

halter.-J. G. Lewis, Fairfield, Neb Mr. Lewis has invented an improvement reating to halters, which is a simple, neat, and of rope and readily adjustable to the heads of different-sized horses. His device also al-
lows considerable freedom to the jaws of the animal, and it can be operated by a farm hand of ordinary intelligence.
Reminder.-V. Sterki, New Philadelphia, Ohio. This contrivance is an instrument for other events desirable to be borne in mind. The device is equally serviceable for business men doctors, lawyers, ministers, teachers, statesmen, and politicians. It may be advantageously used in the home, especially by people having Folding and CREASING DEVICE.-H.
R. Plimpton, 2d, Newton Center, Mass. The
purpose of this inventor is to provide means
used in connection with a circular or used in connection with a circular or other
form of base for folding and creasing galloons, form of base for folding and creasing galloons,
bindings, tapes, and ribbons of paper and other material through the medium of which means the material may be taken from the base in either a folded or creased condition or in its
usual flat condition. PERMANENT HAT-PIN AND LOCKING atTACHMENT.-C. C. G. WOLPERS, New York, N. Y. The intention of this improve ment is to provide a pla which whlle removable from the hat is adapted to remain as long as and to provide the pin with or en thereafter sections removably applied there combo enter and take up such a binding adapted ment with the hair when the hat is placed pon the head and the pin is properly turned as to hold the hat in place.
CONDUIT OR CULVERT.-I. Lane, Toledo, hio. In carrying out this invention Mr. Lane of which may be readily shipped from point to point in sections or detached portions and may be quickly and easily assembled and bound or held in such assembled position through the medium of his improved devices.
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ies of papier mache, ibre, etc. "U. S." Metal Polish. Indianappolis. Samples free. Inguiry No. 4483.-For owner of patent for dustHandle \& Spoke Mchy. Ober Mfg. Co., 10 Bell St.,
Chagrin Falls, $\mathbf{O}$. Inguiry No. 44 Bit $^{2}$-For machine for turningwood
andles for bucket bailing, tub handles, etc.

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(9157) R. A. N. says: 1. What apparatus is necessary to install telephone apparatu transmitters and receivers and such other as is necessary, using the telegraph battery a
battery for the telephone. A. To use a telegraph line with a telephone it is only
necessary to attach the transmitter and re necessary to attach the transmitter and re
ceiver to the Ine. The telegraph battery wil answer for both services. The sounder may
answer for the calling apparatus. 2. There is anotner telephone line on our poles; why is it that we can hear them What you hea from one line to another is called "cross talk." It is due to the electric waves which fill the crossed we can.hear them talk by putting an ear close to the sounder. Why is it? A. The
sounder of a telegraph has long been known sounder of a telegraph has long been known
to be able to receive a telephone message. It is because the sounder is affected by the waves
and vibrates just as the diaphragm of the receiver does. 4. I have read that the electri city flows around the surface of a wire and voltage, as that of the lightning, does not pene trate a wire, but flows on its surface. This is not the case with the current from a battery It penetrates the metal and goes through the ance to its passage than a galvanized wire A. From the answer to the last question you
will see that if a wire is rusty upon its sur will see that if a wire is rusty upon its sur
face only, it can conduct electricity as well as if bright; but if the wire is so much rusted that its body is reduced by the rust, it is quivalent to a wire of the size of its unrusted portion, and cannot conduct electricity a
as one unrusted, of its former full size.
(9158) M. E. C. asks: I wish to put telephone line from our house to one of our you please tell me the best way of running the wires underground? Are the lead-incased wires ground or should they be run through pipes? A. The lead-incased cables can be run by laying them directly in the earth. They are very durable unless a break occurs in the sheati.
To prevent injury from this cause, it is better To prevent injury from this cause, it is better
to use the cable with a core saturated with an insulating substance which repels moisture These can be
of conductors.
(9159) A. H. F. says: I would like for you to answer these inquiries either by
letter or through your Notes and Queries col ump. I would like to know at what speed a trolley can be run constantly or can it be run
at the rate of 60 or 70 miles an hour, with stops at about 35 or 45 miles, without injury to the wires or trolley contacts, such as pulleys think it is impossible to run a trolley and Can you tell me at the rate as stated above highest speed is run and what distance runs are made without stops of about 35 or 45 miles? A. Trolley cars can be run constantly at any speed which they can attain at any time, if the roadway is safe and there is no in the trolley wheel or shoe of the contact with the third rail. Forty to fifty miles per hour has often been .made for a short time, but cannot be maintained on any road because of stops and grade crossings with highways. An experimental track is in existence in Germany upon which over 100 miles an hour has been made. If there was any need of such a roa electrical engineers would undertake to build and operate an express road with 60 miles pe hour and stops at any interval desired. Bu a road, since it is not needed at present.
(9160) J. E. J. says: There are sev eral gasoline engines in this town and the spark or battery gives us more trouble than little. Will you please answer in Notes and Queries what is the best battery, liquid or dry for a small ( $11 / 2$ horse power) engine. Hav you a SUPPLEMENT that gives full information A. Dry cells are usually employed for sparking for a full treatment of the matter; price $\$ 2.50$ by mall.

## NEW BOOKS, ETC

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Emery Grinding Machinery. A Text Book of Workshop Practice in General Tool Grinding and the Design,
Construction, and Application of the
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son, A.M., I.M.E. London: Charles
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Wood. A Manual of the Natural History Timbers of Commerce By of the Boulger, F.L.S., etc. London: Edward Arnold. New York: Longmans, Green \& Co. 1902. 16mo. Pp. 369. $\$ 6$ illustrations, 3 plates. Price, 2.60 .

About 750 woods are enumerated in this excellent book, including most of those which are information is of a very practical nature, dealing with the weights of wood, their hardness and color, odors and resonance, the deood, and a complete catalogue and an excel lent bibliography.

## INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

August if, 1903,
AND EACH BEARINGTHAT DATE.
See note at end of list about copies of these patents.

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Ar brake, railway, P. Jacobson,
Air compressor cylinder. water jacket, $\overline{\text { J. }}$.




Bennett
Animal trap,
Atmosphere,
apparatus



Ball. See Golf ball.
Balls, making hollow, C. Davis.....
Banana shipping case, F. Schmitz.









 Brohe
Brode
Broom
Brush,
Brush,


Brush back drilling and filing machine, c. E.
Fremming R


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 140 Mo


Measuring cabinet, computing, E. J. Austin ..................................... Measuring tool, combination, ©. E. Bince
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Mechanical movement, J. W. Martin....




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Mop wringer. A. M. Burnam
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 Music sheet for mechanical musical ins
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Musical instrument, key wind, B. Paris. Nail holding device, G. H
Nebu1zer ${ }^{\text {T. }}$ De Vilbiss
Nitro


 Nut, lock, J. H. Martin .
Nut, lock W.
Nut or boit lock, W. Whtney. Burn Ordnance, breech loading, w. H. Bevans.
Ore crusher, assayer's, A. Calkins.
Ore separator, Pira \& Salomonso Ores witt solvents, apparatu
ment of, H. T. Durant
Orgai, Arno \& Hagey .... Oven dhoor, A. E. Roberts
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Package ting material, Cot Herbert rivet

 Paper pulp, means for separating magnetic
partcles rom, C. J. Reed
Paper welght and pen holder, combined, w.



 Pipe. See Stovepipe. J. C. Martin, Jr
Ppe coupling, train,
Pisto rod joint, J. D. McFarland, Jr
Pitman, T. Cranin...
Plane, c.
Plant. Faz
.......................

 Plow rotary tool, W. Woreñ.
Pneumetae passageway, J. G. \& M. . . . . . .

 Print, Sounting \& device, Fpatrick-Picar. Sauer....






 Pump shafts in well casings, means $\mathbf{f 3 5}$

 Quick-acting clamp, A. M. Colt
Ouscksilver furnace, A. A. Tregidgo......
Raill shair and cuphing, boitless, Holman







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Stamp, time, w. D. Chandier ..........
Starching machine, H. Grunhagñ.
Steam boller, C. Campus


Stocking stretching device, M. Thus...
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Storage battery
Stove
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